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# EDUCATIONAL RECONSTRUCTION (5)

## Compulsory Part-time Education

THE Government's White Paper on Educational Reconstruction is headed by a well-known quotation: "Upon the education of the people of this country the fate of this country depends". That, of course, is profoundly true. It states the broad problem of the future in undeniable fashion. But it has been also significantly underlined by the Prime Minister when he said: "The future of the world is to the highly educated races who alone can handle the scientific apparatus necessary for pre-eminence in peace or survival in war". Implicit in that statement is the need to know what *kind* of education we are to provide for those who are to follow us.

The White Paper is necessarily concerned with the machinery rather than the content of education. But the structure of the machinery is obviously not without its indications of content possibilities, since it at least shows us something of the scope of education which the machinery will permit.

Consider the proposals for compulsory part-time education, since the main criticism of our present full-time education arrangements is directed at this aspect. Full-time education ceases about the age of fourteen. What does that mean to us if we are really considering education as something upon which the fate of Great Britain—and that means the fate of the children of this country—depends? Sir Richard Livingstone has summed up its meaning in one vivid phrase: "To cease to be educated at 14 is as unnatural as to die at 14". But in case the phrase be open to any quibble at all, let us use an equally vivid and descriptive phrase which occurs in the White Paper itself. If the effects of education carried on only to the age of fourteen are thin and liable to wear off quickly in the rough and tumble of the industrial and commercial world, the language of photography provides us with the reason. "The process of education for the vast majority of children", says the White Paper, "offers at present an example of 'under-exposure, under-development and insufficient fixing'."

Something has to be done then to remedy the defect, and the first step is to raise the school leaving age to fifteen and, later, to sixteen. But even that is not enough. The full value of raising the school leaving age will not be secured unless the results are consolidated. How is that consolidation to be secured? There must, says the White Paper, be continued supervision of the health of young people after full-time schooling has ceased, and opportunity must be provided to develop their capacities and interests. The present War very quickly showed us that if the provisions for day continuation schools in the Education Act of 1918 had been operated, many of our present problems would not have arisen.

The White Paper therefore makes it clear that "all young persons from 15 to 18 will be required to

attend an appropriate centre part-time, unless they are in full-time attendance at School or otherwise under suitable part-time instruction". The attendance will be taken from hours of employment and, at first at any rate, will be limited to a day per week or its equivalent. Moreover, we are glad to note that the old title of 'day continuation school' is to be abandoned, and 'young people's colleges' substituted. That, indeed, is not the best title, but it is better than a title which might indicate that what is to be done is a mere extension of previous schooling. The point to be emphasized is that a new phase of life and development is to begin.

We need not enter here into details of variations of a general plan which may have to be made. The rural areas present problems which will have to be resolved. So also do the cases of young persons serving at sea. But these matters are noted and recognized by the White Paper and will, we hope, be brought within the scope of the new proposals without excessive difficulty.

Already we have pointed out that the proposals for this new machinery give indications of the scope and content upon which interest and thought must be concentrated. The indications are clear so far as the young people's colleges are concerned. The young people concerned will be engaged in a variety of occupations. For all of them, however, there are basic elements which must be included in their training. Thus "provision must be made for their well-being through physical training and remedial exercises and instruction in health and hygiene. The school medical service will be extended to cover them. . . . Other essential elements will be training in clarity of expression and in the understanding of the written and the spoken word, together with some education in the broad meaning of citizenship to give some understanding of the working of government and the responsibilities of citizens and some interest in the affairs of the world around them".

If that be achieved, we believe a prime move will have been made to produce people who can "handle the scientific apparatus necessary for pre-eminence in peace or survival in war".

## Technical, Commercial and Art Education

We turn now to the proposals for "Technical, Commercial and Art Education", and here we note one of the two major issues to which the White Paper directs attention: the need for the further development of these branches of education.

That need has been heavily underlined by the War. We know now how vital a contribution has been made to the war effort by the technical colleges. They have, to put the matter quite mildly, not only trained munition workers and members of the Forces; they have also worked miracles as production centres. The White Paper recognizes their contribution. They have "made a contribution to the specialized training of the personnel . . . the value of which cannot be over-rated . . . they have shown, notwithstanding the handicaps imposed by war conditions, that they can assist in effective training to a degree and in a way, the possibilities of which industry has not hitherto generally appreciated". Vast developments in industry and commerce are now envisaged, and we have in these columns already indicated the need which will exist for special training. It is well, therefore, to note that the White Paper suggests that "industry and commerce should review their arrangements for training, and should co-operate in associating the technical colleges and art schools more fully with the industrial and commercial life of the country".

Our present system—and the White Paper interpolates the remark "if it can be called a system"—will clearly be insufficient and inadequate to the calls the future will make. We note, for example, that at present the provision of further education is a power and not a duty of the local education authorities, and technical education has not advanced in concert with the needs of a highly industrialized community. We note, too, that "in particular the standards of the buildings and equipment in use have often been deplorably low, and comparison with what can be seen in other countries which have been our competitors in the world markets, can leave little cause for satisfaction". In pre-war days a programme for the provision of colleges and the expansion and bringing up to date where necessary of others already in existence had been made, and for that purpose capital expenditure of some £12,000,000 was contemplated.

The White Paper indicates that this is to be remedied. The cost will be considerable. That is recognized: "The post-war cost of such a programme will inevitably be higher [than the £12,000,000], but it will be of the first importance that these plans should be revised and expanded to meet the new requirements, and, as soon as possible, carried into effect". With that in mind provision will be made to place a duty on education authorities to provide adequate facilities for technical, commercial, and art education, both full-time and part-time.

So far, so good. In general the White Paper's proposals must be regarded as satisfactory up to that point. But it is here we must turn to the appendix to the White Paper which deals with the financial implications of all the proposals. We are warned that "it is not proposed to introduce any of the proposals until after the war". Thereafter there is a plan which will occupy some four years, and "the development of technical and adult education is not included among the matters to be dealt with in the first four year plan". Nevertheless "some allowance has been made for preliminary expenditure in respect of technical education".

How much? The allowance for "preliminary expenditure" is to be made two years after the White Paper scheme begins to operate, and it will form only 1·11 per cent of the total educational expenditure. In the succeeding years this percentage falls to 0·82 per cent, and then, in successive years, becomes 0·58, 1·21, 2·45 and 2·98 per cent. Thus, seven years after reconstruction has begun, less than 3 per cent of educational expenditure is concerned with technical education.

The Parliamentary Secretary to the Board of

Education, in a recent debate, said that the figures represent the capital charges on new buildings. We wonder what new buildings are to be secured for an expenditure of these dimensions. And, in the meantime, what is to happen about the equipment which so clearly must be provided? What estimates are envisaged to secure the greatly increased recruitment of the highly qualified and experienced teaching staff which will be necessary?

We can provide no answers to these questions. We record, as of course anyone must record if the need for educational reconstruction be clearly known and appreciated, our admiration of the broad sweep and character of the proposals which the White Paper has adumbrated. But we cannot help expressing the fear that, if so much time must elapse after the War before the real and concrete work of educational reconstruction can begin, there will be a very clear danger that the high hopes the educational proposals have raised may very easily be disappointed. We do not pretend to ignore the difficulties. Of course there will be difficulties. No one knows when the War will end. There will be many things to be done when it does end; things which will be called priorities and which indeed will be noble and inescapable priorities. But when we talk of technical education we believe we talk of something which is inextricably linked with the welfare and success of that vital industry and commerce upon which will rest the possibilities of so many of the social improvements the country expects. There must then be no lapse of time in reforming our present system so that it may meet the demands which will be thrust upon it.

We hope, then, that the Government will review its time-table of educational reconstruction and give swift and real meaning to the proposals we have noted and long to see put into effect.

## THE FUTURE OF TECHNICAL COLLEGES

THE correspondence which has been proceeding in the columns of NATURE under the heading "The Future of Technical Colleges" is both timely and important. Recent publications, such as the White Paper on Educational Reconstruction, and the still more recent report of the Parliamentary and Scientific Committee on "Universities and Research", show a growing awareness of the fact that if Great Britain is not to be overwhelmed by the rising tide of science, it will be necessary to mobilize all the scientific and technical ability the country can muster. We shall need all the pure scientists we can discover, a far greater number of first-class technologists, and an innumerable host of skilled technicians. In the education and training of this army of reconstruction, both the universities and the technical colleges must play a part, and the task is, quite frankly, beyond their present resources. Before public money is spent, as it must be, on increasing those resources, it is clearly desirable, in the interests of economy of both money and man-power, that the respective functions of the universities and the technical colleges shall be clearly defined, and each of them equipped for their appropriate functions.

It is unfortunate that a single rather emphatically worded sentence in Dr. Lowery's letter in NATURE of August 21 should have been construed as an attack on the quality of the instruction given in the technical colleges of Great Britain, since the volume and vigour of the quite natural reaction has rather swept the discussion from its most fruitful channels, and has caused the many admirable suggestions made in that letter to fall somewhat into the background. No one would question that, in days when universities were few and university scholarships both hard to come by and inadequate in amount, technical colleges performed a valuable service by stepping into the breach, and enabling men of high ability, who through lack of funds were unable to obtain the university education which their talents would have justified, to establish themselves in the scientific world by means of an external degree. The system whereby such men should have to depend for their education on the classes available in the local technical colleges, often after the end of a full day's toil, cannot be regarded as more than a temporary expedient. It no longer satisfies either the social conscience or the urgent needs of the times. As the White Paper states, "high ability should not be handicapped by accidents of place of residence or lack of means in securing a University education". Courses in technical colleges, however efficient the instruction and equipment, do not constitute a university education; nor can the matter be entirely rectified by affixing the stamp of an external degree to the product. The fact that in some of the larger cities of Great Britain a university and a technical college may be found flourishing side by side, shows that the two types of education are not felt to be identical (City Fathers are not usually guilty of extravagance in matters of education) and that in a complete educational system each is needed to supplement the other.

It is important that this duality of function should not be overlooked in planning the reorganization and extension of higher education. It is an expression of a similar duality in human interests: on one hand, the desire to understand; on the other, the desire to construct. Each is essential to human progress. Each requires its appropriate type of training. The primary function of a university is the conservation and extension of learning, and the training of men and women who shall carry on this tradition. Every university department is, or ought to be, a research department, and it is for this reason, rather than for any supposed superiority in equipment or standard of teaching, that it is important that students whose interests and aptitudes mark them out as the research workers of the future should receive their education within a university.

From a utilitarian point of view—there are, of course, others—the importance of such students lies in the fact that the science of to-day becomes the industry of to-morrow. Relative to the large number of technicians and technologists who will be required

to staff our industries, their numbers will probably always be small. As Sir Lawrence Bragg has pointed out, the output of first-class physicists, for example, is only about one per annum per million of the population. Our survival as a great industrial nation may well depend on doubling our production of university graduates in pure and applied science.

For the training of the great army of technicians which modern industry demands, we must look, not to the universities but to the parallel branch of education which is represented at present mainly by the technical colleges, and for two reasons. In the first place, many capable technically minded students find the wide range and strict mental discipline of a university course both difficult and distasteful. In the second place, the power of a university to fulfil its own special function in the community depends on an equal and harmonious development of all its faculties. A wholly disproportionate growth of the technological faculties would so seriously impair the fabric that the institution would almost cease to function as a university at all.

The arguments which have led the Norwood Committee to recommend the division of secondary education into academic (grammar school) and technical apply with equal force in the sphere of higher education. As the students from the grammar schools look to the universities for their further education, there should be technical colleges of similar status to which the student from the technical secondary schools can look for further training. Few of the existing technical colleges of Great Britain, handicapped as they are by the necessity of providing an immense number of courses for students of the most elementary type, can be said adequately to satisfy these requirements. What is needed, as Messrs. Barber and Andrews have already urged in their letter in NATURE of October 2, is the development and adequate endowment of a sufficient number of institutes of technology, corresponding to the Technische Hochschulen of the Continental system, capable of playing the part in technical education which the universities fulfil in pure and applied science and the humanities. Such institutions would need no stamp from an external university to guarantee their students. Their existence would give a new status to technical education as a whole.

The relations between these new colleges, the local technical colleges and the applied science departments of the universities, clearly call for much thought and mutual consultation, if wasteful overlapping of functions is to be avoided. So also, as has already been pointed out in the leading article in NATURE of October 16, does the method of apportioning the students to the most appropriate institution. The Board of Education, as guardian of the technical colleges, might well initiate such consultations. The Government is being pressed, and rightly so, for large capital grants both for university and for technical education. It is important that their relative functions shall be wisely decided before the money is spent. The opportunity of obtaining an adequate and well-balanced system suited to the needs of the times will not soon recur.

# TECHNIQUE OF BLOOD GROUPING

## Blood Grouping Technic

**A Manual for Clinicians, Serologists, Anthropologists, and Students of Legal and Military Medicine.** By Dr. Fritz Schiff and Prof. William C. Boyd. Pp. xiv+248. (New York: Interscience Publishers, Inc.; London: Imperia Book Co. Ltd., 1942.) 5 dollars.

DR. BOYD in the preface to this book states, "Some years ago Dr. Schiff approached me with the proposal to assist him in getting out an up-to-date book on blood grouping technic, somewhat on the lines of his well-known book in German—(Die Technik der Blutgruppenuntersuchung)". An English version of this Continental classic, revised and brought up to date, would always be welcome.

The translation of the senior author's script by Dr. Boyd has been masterly. With its concise, clear and straightforward sentences, this book is a model of modern English style. The title describes it as a manual for clinicians, serologists and anthropologists, who will welcome it for the wealth of its contents. Students and tyros in serology will likewise welcome the book for the clarity of the presentation of the material.

Chapters 1 and 2 on the theoretical foundations and general technique of blood group determination give a brief but comprehensive survey of the subject. The methods considered in Great Britain to be the most reliable are strongly recommended by the authors, who at all times stress rightly the need for adequate controls to all group determination. The *A*,*B*,*O*, *M*,*N*, and *P* factors are all well and fully dealt with. The *Rh* factor is described briefly and in the light of modern knowledge rather inadequately. (This is accountable for by the fact that the book was published in 1942 and therefore probably written in 1941.) Only the earliest work of Landsteiner and Wiener and of Levine, Katzin, Vogel and Burnham is quoted.

Chapter 3 describes the application of blood grouping techniques. First, there is the application to blood transfusion. Careful grouping of both donor and recipient and equally careful cross-matching are constantly stressed. The choice of a donor—friend, volunteer or professional—is discussed, and the regulations governing blood donors and blood banks in New York City are quoted. The section on blood and plasma banks might well have been omitted or alternatively elaborated.

Secondly, the problems of relationship, including disputed paternity, are discussed *in extenso*. The authors insist that, although the principle of the procedures can be understood by all, the actual tests should be entrusted only to experts. An expert is defined as a person, with adequate scientific training, such as is symbolized by the degree of Ph.D., Sc.D., M.D., or equivalents, who for a number of years has been carrying out blood grouping tests and conducting research in serology as applied to blood groups, and the emphasis is placed on the research worker rather than the routine hæmatologist as the expert of choice.

Thirdly, other forensic applications are considered. The identification of blood stains is also regarded as a procedure only to be undertaken by those with experience in the techniques involved. These are fully described. The methods of testing

organs, secretions, and body fluids other than blood, are also noted.

Fourthly, an account of the related factors, including the Forssman antigen, in animals is given.

Finally, blood group investigations in anthropology are described. "Blood group determinations are characteristics genetically determined, by a known mechanism, absolutely objective in character, absolutely unaffected by environment, not subject to mutation at any rapid rate, and, so far as we are able to discover by extensive investigation, non-adaptive. If it is possible to discover anything about the course of human evolution by classifying mankind, the most useful data should be the blood groups". This attitude of the author (or authors) is the keynote of an interesting section. Once again a reliable technique and a careful evaluation of results are emphasized. Methods of examining archæological material, mummified tissues and bones, are also given.

Forty-five figures and sixty-seven tables are included in the book. On the whole they clearly illustrate the text, though in a few instances diagrams are presented with little accompanying explanation, which may be confusing to the uninitiated.

The number of references to the literature, it is claimed, has been reduced to a minimum, but the number will be adequate for most readers.

JOHN F. LOUTIT.

## FOREIGN TRADE AND TARIFFS

### Trade Regulations and Commercial Policy of the United Kingdom

By the Research Staff of the National Institute of Economic and Social Research. (National Institute of Economic and Social Research, Economic and Social Studies No. 3.) Pp. x+275. (Cambridge: At the University Press, 1943.) 15*s*. net.

THIS book is a portion of the British contribution to a study of international trade regulations and commercial policy which was initiated at Geneva in 1938, and which was designed to give a comprehensive picture of the major changes in the methods of control of world trade since the conclusion of the War of 1914–18. The outbreak of the present War has interfered with the completion of the project as originally conceived; but it has been thought desirable to publish the descriptive material now, leaving certain statistical studies and consideration of the economic issues along with an examination of the changing international economic position of the United Kingdom for discussion in a later volume. This was undoubtedly a wise decision; for in the present work we have, as the chairman of the Council of Management of the National Institute of Economic and Social Research remarks in his preface, a technical descriptive study which provides a convenient and more detailed picture than has hitherto been available of the development of British commercial policy, and particularly of Protectionism in all its forms, up to the end of 1938.

What has happened since then will cause more profound changes in Britain's future economic position in the world than even the booms and slumps and tricks and experiments of the 1930's. This is well left for future study.

It is not to be expected that a work of this kind, sponsored by a committee and finally revised by one of its members, would be much more than an objective and an accurate account of Acts of Parliament, commercial treaties, statutory rules and orders and the like. Even if it were only this, a very great debt of gratitude would be due to the National Institute for getting so much into so convenient a compass. But the book is something more than a catalogue, and the reader who wishes, to take one example, to study the course of Imperial Preference, will find much to help him in addition to the mere enumeration of negotiations embarked on and agreements concluded. It is, however, strictly limited in scope and its plan requires it to omit an account of the background prior to 1914 against which its contents have always to be pictured.

Many of the difficulties in trade encountered in the 1930's can be traced to origins back in the free trade period just after the middle of the nineteenth century. It was then that the Dominions imposed tariffs and began to build up infant industries which drove out home products from the Colonial markets. Soon, they claimed complete economic autonomy, and after the War of 1914–18 they assumed, in due course, all the powers of independent States. At Ottawa in 1932 they succeeded in inducing the United Kingdom to adopt a policy of tariff exclusiveness and thus laid the foundations of what was hoped would become an imperial economic unity. In all this they took the initiative, and the measures they advocated were directed primarily to secure their own economic interests rather than those of the mother country. Perhaps, as events have turned out, this was not altogether a bad thing. But the present War will leave them (certainly some but, possibly, not all) still stronger as against the United Kingdom than they were in 1938. Dominion status, in consequence, may require a new Statute of Westminster to deal with a greatly altered situation, and considerations other than economic ones will probably assume major importance in the settlement that will then ensue.

But these changes in the mutual economic relations between the component parts of the British Empire were part of a development which was widespread throughout the world. A period in which raw materials and semi-finished goods of foreign origin were imported and worked up to be exported as finished goods to other countries was being superseded by a period characterized by the exchange of manufactured goods for manufactured goods, in which the international movement of raw materials tends to fall and every country to work up its own resources. British politicians and economists were slow in recognizing this trend, and one of the latter could write in 1914 that so far as he could foresee "a large interchange between countries of foodstuffs and raw materials against manufactured goods is destined to continue for an indefinite time to come". The War of 1914–18 stimulated the movement, and in 1925 the Balfour Committee on Industry and Trade was able to diagnose the situation correctly in its "Survey of Overseas Markets". By 1938, taking Japan, Canada and Italy as examples of industrially young countries creating their own national industries, the volume of the international trade of these countries with one another and the rest of the world was much below that of 1929. This is true, also, of other countries industrially older, and particularly of Russia. Indeed, it was the industrialization of Russia, depriving Germany of raw materials and of a market for the sale of finished products, which caused Hitler, as many passages in "Mein Kampf" testify, to look

to that country as a source of supply at any cost for Germany of materials not found in sufficient quantities at home—materials to be obtained by force when trading methods failed.

That the United Kingdom experienced similar difficulties is demonstrated by the detailed story of tariff-making as set out in the volume before us. What lessons can planners and reconstructors learn from this? Are they to assume that the tide will continue to flow in the direction it took in the 1900's and maintained so strongly in the 1930's? If so, then they ought to aim at what is called a 'balanced' agriculture, at production of high-quality goods by skilled craftsmen, at the development of small-scale rural industries, at wide diffusion of ownership of capital, land and houses, at anti-trust legislation and the like. But if they conclude that the trend has run its course (and there are some grounds for this belief) then public ownership and control of large-scale industry with the State alone engaging in international trade might well be the policy to pursue. The choice is not an easy one to make. It is disquieting that the most vocal of the planners seem unaware that choosing is a necessary preliminary of action.

J. G. SMITH.

## THE BIBLE EXAMINED

### In Search of the Real Bible

By A. D. Howell Smith. (Thinker's Library, No. 98.) Pp. v+120. (London: Watts and Co., Ltd., 1943.) 2s. net.

TO the question, What is the real Bible?, the answer is that it resembles an ancient city site where many cultural strata exist one below the other. If the archæologist digs deeply, he will discover some very primitive remains, while nearer the surface lies more recent, and perhaps more advanced, material. Thus Mr. Howell Smith has no difficulty in unearthing some primitive and, to us, unpleasing elements in the Bible—deceptions, obscenities, and barbarities of various kinds. This should shock none but the Fundamentalist, who cherishes a preconceived and untenable idea about the Bible; the well-informed man knows that all primitive literatures display parallel traits. It is equally easy to show that the biblical cosmology and science are no longer tenable; though it would be an error to imagine that only one cosmology exists in the Bible. Of the Deity, varying conceptions are present in the Bible, as Mr. Howell Smith shows, and as one would expect from this fairly complete record of a development of religious ideas, which is what the Bible is.

Mr. Howell Smith supplies the reader with a clear and quite fair summary of the results of what is known as the Higher Criticism. He is inclined to overstress the divergences of opinion among scholars, who are pretty well agreed as to "the approximate dating, mode of composition, and historical value of the different books". Only the mentally indolent will be "bewildered" or reduced to believing "that perhaps the Fundamentalists are right in dismissing all biblical criticism as a mass of arbitrary speculations". For this reason it is to be regretted that Mr. Howell Smith did not include a brief description of the methods of the biblical critics, which are indeed very simple. There is nothing abstruse or recondite about them.

Mr. Howell Smith pays tribute to the high cultural value of some parts of the Bible. "The Canon of the Hebrew Prophets contains some of the most exalted literature mankind has produced, and many of its pages are afire with hatred of oppression and injustice". *Job* is "one of the greatest literary achievements in the world". *Ruth* is "a charming tale of loyalty and kindness". *Jonah* teaches "lessons of mercy and forgiveness". With regard to the last book, it might have been added that here alone in the Bible is displayed a delicate sense of humour.

Not the least interesting chapter of the book, "The Spade and the Critic", discusses the bearing of recent archæological discovery on the historicity of the events recorded in the Bible, and upon our knowledge as to the sources whence certain biblical ideas were derived. Perhaps most students will agree with Mr. Howell Smith that Sir Charles Marston's recent attempts to make the stones of Egypt and Mesopotamia refute the critics have not been very successful.

Of course one's estimate of the value of the Bible will depend very much upon the estimate one holds of the value of religion as an element in human culture. Mr. Howell Smith would not appear to place that value very high; and this necessarily involves a certain lack of sympathy with his subject. But apart from this defect, Mr. Howell Smith has written an informative little book.

J. C. HARDWICK.

## AGRICULTURAL CROPS OF THE UNITED STATES

### Field Crops

By Prof. Howard C. Rather. (McGraw-Hill Publications in the Agricultural Sciences.) Pp. ix+454. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1942.) 26s.

THIS book sets out to describe the general principles underlying the cultivation of the principal agricultural crops grown in the United States, in a form suitable for first-year students in agricultural colleges. The book covers the principal American crops very evenly. It includes pasture and meadow management and the growing of leys and forage crops, particularly leguminous ones, with their attendant problems of grazing control, hay- and silage making and seed production. The cereals and pulse grain crops, and the typical American crops of maize, tobacco and cotton, are naturally dealt with, but potatoes and sugar beet are the only root crops discussed, the typical British root crops—mangolds, swedes, turnips and kale—not being mentioned.

The text is always clear and straightforward, and well supplied with actual examples, tables, figures and illustrations. The great difficulty of the subject is that the general principles underlying the variations in the actual methods of growing a particular crop over an area the size of the United States are still only imperfectly understood, and this difficulty is reflected in the book; for the general principles are often only implicit in the text, so that a student unfamiliar with the conditions in the various States will sometimes have difficulty in appreciating the factors controlling the cultivations used. The value of the book is that it contains in one volume material that is either only obtainable in encyclopædias and in a mass of separate bulletins, or else is only cursorily dealt with in the elementary agricultural books.

E. W. R.

# A TECHNOLOGIST LOOKS AT THE FUTURE

THE address delivered by Dr. C. R. Burch on the occasion of the presentation to him on April 9 of the nineteenth Duddell Medal of the Physical Society took the form of an outline account of certain advances in physical technology in which he has taken part, set out with the view of demonstrating some of the circumstances and conditions which made those developments possible.

"These may perhaps illustrate the kind of conditions that we have to establish in the future, if we want good technological progress to be made in Great Britain. And it is vitally important that we should stand in the technical forefront—at least as important in the coming peace as in the war. Here is something we cannot afford to neglect: whether we like it or not, whether the politicians like it or not, technical progress, more than any other controllable factor, is reshaping our brave new world. We have to produce a contribution at least as constructive as that of our Allies: if we fail in that, we shall not keep their respect, and if we do not keep their respect we shall certainly lose their alliance."

Dr. Burch's story opened about twenty years ago, in Metropolitan-Vickers, when Dr. T. E. Allibone was working on the preparation of zirconium as the basis of a long-term programme devised by Dr. A. P. M. Fleming. Zirconium was known in powder form, and the investigation aimed at producing it in coherent metallic form, with the view of examining its properties. The question of industrial use was a dim prospect; the immediate task was to gather knowledge. It was decided to try the induction furnace, and it proved successful; but so far as could be seen at the time, neither the metal itself nor alloys of it were of any commercial value. Nevertheless, the effort had not been wasted time, for it had produced a team of three men, Allibone, Burch and Ryland Davis, who had gained considerable knowledge and experience of vacuum work, high-frequency technique and the application of H.F. currents and induction heating, together with "something of the artist's sense of enjoyment, emotional drive, call it what you will, that arises from widening the range of one's experimental inquiry".

Ryland Davis and Burch continued with the development of induction furnaces, leading to a ¼-ton furnace which would melt brass or copper at 50 cycles or steel at 500 cycles in place of the million cycles necessary in their earlier furnaces.

"The coil for this furnace was about the size of a small dustbin—a coil of one layer of 1 in. × ⅛ in. copper strap, wound on 'high edge'; 130 turns of it in a length of 24 in. or so. It had to be water-cooled on the outer edge of each turn, so as to leave a radial thickness of 1 in. of solid copper on the inside of the coil. The Transformer Department wound the coil for us. But we had to tackle the water-cooling ourselves. This we did by adapting a device called a 'mica undercutter' to mill a semicircular groove round the outside of the coil, and in the groove we soldered sixty lengths of ¼ in. copper tube—a total of about 200 yards of it, providing sixty separate inlets and outlets so that enough cooling water could be got through the coil to remove the 30 kW. resistance-loss that occurred in it, when it was used on brass, or the rather smaller loss which occurs in it when it is used on steel. I should like to record our thanks to Mr. Hutchinson, now of Sir George Thomson's staff, who helped us solder that interminable joint. I do not say that coil was a thing of beauty. But it did its two-fold job. Here may I touch once more on the future?

"Let us do all in our power to make it possible for the embryo physicist of the future to satisfy fully any desire he may have to acquire knowledge of crafts and skill in the use of tools. I cannot assess too highly in this respect the education I received at Oundle School. I use deliberately the phrase 'education' in the use of tools rather than 'training' because again and again I have been struck by the extent to which such craftsmanship and manual skill as I possess has helped me to form happy personal relations rapidly with all sorts and conditions of men. As that is an extremely important part of life, I am not going to apologize for digressing into a brief analysis of the operative factors. On the conscious level, the existence of a common manual skill or craftsmanship provides a link of mutual respect, and mutual respect is almost invariably an essential pre-requisite to friendship. On the unconscious, or as some psychologists prefer, unwitting levels, the acquisition of a similar craftsmanship provides a number of similar links between ideas, and, what is far more important, similar links between ideas and emotions, so that similar emotions are the more readily aroused, and similar ideas the more readily 'intuited'—in short, the two men are the more readily in sympathy. Of course, if the skill has been acquired reluctantly under compulsion, any related idea is the more likely to arouse the emotion of hostility, and the idea of hostility, and even, at a higher level of mental integration, something far worse—the ideal of hostility. For that reason I would not for one moment advocate imposing in the sacred name of education compulsory courses in workshop practice for all and sundry, or even for all physicists. No! That isn't my 'ideal' at all. Rather would I see courses of this type run simply for such as care to attend.

"I should like to touch on two other aspects of the value of work with one's own hands. First, in design: in my experience it has only been physicists who do not make their own apparatus who have been apt to persist in designing things that are quite incredibly difficult and expensive to make—difficult out of all proportion to the very small gain associated with the design in question. When you explain this to them, they see the point, and not without a certain bitterness do they complain that they must keep a conscious and exhausting watch for pitfalls of construction which those 'educated' in the use of tools very largely avoid as it were unconsciously and reflexly, by sympathy."

The 500-cycle ¼-ton steel furnace being made, it had to be shown that it could be used to make alloy steels. In the face of the scepticism of practical steel-makers, the difficulties of 'teeming' the molten steel were overcome, and the 'electric fountain' effect, due to the magnetic field of the coil acting on the eddy currents in the molten charge and causing the metal to well up in the centre and run down at the sides, was found not to distribute small particles of slag through the metal. All this took more than a year to accomplish, and useful information on 'chilling' and 'burning' of cast metal was obtained.

Dr. Burch emphasized here that although Ryland Davis and he made part of the first ¼-ton furnace with their own hands, and supplied in some measure

inspiration and technical leadership, the development, even at this stage, had only been possible by the co-operation of many others in the Research Department and in other parts of Metropolitan-Vickers. By 1934 there was installed in Sheffield a total induction-furnace capacity of 13 tons of furnaces capable of simultaneous running, and 6,000 kW. of generators. By 1939 this had risen to 38 tons and 16,000 kW. of generators. As the power consumption is about 600 kWh. per ton, this means that in 1939 Sheffield could turn out 600 tons per day of induction furnace steel.

"Thus the part played by Ryland Davis and myself, building on the foundations laid by Northrup and others, is itself already in some sense out of date, and is but another foundation on which a younger generation is building; and that, some say, that transitory and ephemeral aspect of technological achievement, is just what deprives it of cultural value or spiritual satisfaction. I cannot agree with that view at all. For it is the special glory of our science and its applications that the more it changes, the more it is the same thing. I am sure that all who have taken part in any technological development will have found as a concomitant of achievement a fuller realization of the underlying unity of past and present, and a lasting satisfaction of the kind that can endow even tragedy with triumph. These are matters not capable of precise definition, but expressible only in terms of mysticism and of poetry. When the subject is technology, one turns naturally to Kipling—may I remind you of his poem 'The Palace', in 'The Five Nations'?"

In the second part of his address, Dr. Burch turned to other of the end-results of Dr. Allibone's work on zirconium and its alloys. The Process and Insulation Department of Metropolitan-Vickers wanted to try the effect of a really good vacuum on the process of impregnating porous insulating materials with transformer oil, with the view of increasing the dielectric strength. One difficulty was that the impregnator had to work in a steam-jacket. The problem re-awoke in Dr. Burch an interest in distillation as a process worth experimenting with; in particular, vacuum distillation, if approached from the kinetic theory aspect, seemed promising, as a means of distilling substances which had not hitherto been distilled.

Accordingly, Burch, in association with Watts and Bancroft, constructed a vacuum still in which the condensing surface took the form of a cooled roof immediately above the evaporating pool of liquid, so that rate of distillation is limited only by rate of vapour creation. There was something of the 'heads-I-win, tails-you-lose' about the experiment, for either substances would distil in this still (and that would be useful in chemistry), or else they would not (and hence had very small vapour pressure and would be useful as sealing compounds for vacuum joints). After using the still for a week or so, the fascinating idea came to Dr. Burch that, since lubricating oil distilled in this still at temperatures 100° C. or so higher than that required for mercury, it might replace mercury in a condensation pump, and so dispense with 100° C. of artificial refrigeration in making high vacua. This made possible high-power demountable valves and X-ray tubes.

"So once more there were developments involving the co-operation of a great number of people. Dr. Allibone decided to develop demountable X-ray tubes, and eventually made the million-volt tube of the High-Voltage Department of St. Bartholomew's Hospital: Mr. Bancroft, Mr. Preece and Mr. Burrows made the pumps and the continuous vacuum still to make the oil for the pumps, and the vacuum still with which Carr and Jewell of British Drug Houses first distilled vitamin A—for a wider group is involved than simply that of Metrovick. Further, we were not the only team to experiment with molecular distillation. While we were making our first still, and quite independently, Dr. K. C. D. Hickman of the Eastman Kodak Co. in Rochester, N.Y., was tackling similar problems in very much the same way. Other teams from British Drug Houses, Imperial Chemical Industries, Shell-Mex and the Bataafsche Petroleoum Mij. also co-operated in the development of application of molecular distillation.

"Returning to my own special interest—valves: I made demountable 3-electrode valves, while my brother developed a 30 kW. demountable 4-electrode valve, which was so far as I know the first screen-grid valve of that power made in Great Britain. I should like to acknowledge our great debt to our colleagues in this work, Mr. Ludlow, Mr. Phillips, Dr. Sykes, until his translation to the National Physical Laboratory, and Dr. Dodds: if it was our privilege in the beginning to have given in some measure inspiration, it was their collaboration that made the development successful, and their inspiration that has carried it on. I should like also to express our gratitude to the radio staff of the General Post Office for their unfailing co-operation during the 'teething' troubles of demountable valves in the Rugby radio station.

"I have spoken of the co-operation of a team. But what of the man behind the team? Here I should like to say specifically: All that my colleagues and I at Metropolitan-Vickers have achieved in this work, we owe ultimately to Dr. A. P. M. Fleming. That raises the question: What of the future? How shall we choose men to do the kind of job that Dr. Fleming is doing?

"I do not believe that a scientific man keenly interested in personal research is likely to be the best man to choose for that kind of administrative work, because his emotions will in general be too firmly linked with his personal research, and he will find it too difficult to dissociate these emotions in making judgments on points of policy. I think that a scientific man who has ceased to be interested in personal research may well develop the qualities needed for deciding questions of policy in long-term research, especially if he retains or acquires an interest in the personalities of research workers, for I have the strong impression that the question of whether a particular line of work will or will not prove fruitful for a given organization may often be determinable less by logical than by psychological considerations. But, above all, avoid appointing a 'man of mature judgment'—and that phrase I take to imply a man whose judgments are determined entirely by his emotions: whose emotions are keyed indissolubly to the events of his remote past, and who is totally unreceptive to new ideas except in so far as they may arouse fortuitously the emotions belonging to a bygone age.

"I have touched on the psychology of the research worker, and that brings me to the question, What are the factors which determine whether a man shall be likely to have original ideas on a given subject, and be keen to work on it? For a knowledge of these factors may well influence our policy in the education of research workers. I have just one suggestion to

make: it is that at any rate for an appreciable percentage of researchers—I do not say for them all—we have to do with a factor which the psychologists like to refer to in German (possibly because it is so marked a characteristic of the German nation): a *Wiederholungsdrang*: a repetition urge: a tendency to repeat patterns in life. I would suggest, then, that scientific or technological researches tend to be in some sense grown-up variants of some more youthful form of activity. If this is so, to find the ultimate foundations of success in research, we may well have to go back beyond the university—to the public school, or even to the preparatory school. Here I should like to acknowledge once more the very great debt that I owe to Oundle School, particularly in that they let me experiment with the small-scale semi-technical distillation of coal tar, because I wanted to. Coal tar at atmospheric pressure, 1918: oil in a vacuum, 1928!

"What of education in the future? I look on it as an important indirect contribution to our long-term research policy to provide in our schools facilities for the keenest, at any rate, to follow up almost whatever kind of extra-curricular activity may strike their interest—and this without binding themselves in any way as to their future careers. This foretaste of achievement in following up individual interest provides, I believe, the strongest possible stimulus to education, and if the nature of the interest should change, the stimulus remains the same. The cultivation of enthusiasm I take to form the first requisite in that far-sighted educational policy and that courageous long-term research policy to which I look forward in the future, after the War."

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# AGRICULTURAL DEVELOPMENTS IN THE U.S.S.R.*

By Sir JOHN RUSSELL, F.R.S.

PRIOR to the Revolution three systems of farming were practised in the U.S.S.R.: (1) large estates; (2) small peasant farms; (3) peasant land farmed by the peasants under the *Mir*, the village council or commune of very ancient origin.

Some of the large estates were run on good modern lines, some were put into the hands of managers whose business it was to extract all they could for the owner, others were moderately well managed. The peasant farms were small holdings owned by the individual farmers, which had resulted from the various agrarian reforms, the most important of the later ones being those of Stolypin (1905), who had a Danish adviser and was aiming at the Danish model. The peasant land under the commune (*nadiel* land) belonged to the body of peasants but not to any individuals; it was parcelled out into many strips which were periodically distributed by the *Mir* among the peasants in accordance with the size of family, etc. These strips were scattered over the whole area so that each man should have his share of good and of bad soil. In the time of the Revolution it was estimated that about 45 per cent of the cultivated land was in the hands of the peasants.

All three systems were disliked by the Bolsheviks, the first two because they involved private ownership of land, and the third because of its grave inefficiency and the utter impossibility of introducing modern improvements. The Bolsheviks also disliked the peasant mentality, so utterly different from that of the factory worker. The peasant wanted to sell his products at high prices while the factory worker wanted to buy them cheaply. The factory worker was accustomed to work in masses for an employer, and had before the Revolution no sense of proprietorship: the peasant was used to working alone or in small groups and always felt that he owned the land he tilled.

After some experiments, State farms were set up which accorded well with Bolshevik theory. The peasants were employees of the State receiving a weekly wage, living in great blocks of dwellings in a central area developed like a town. The whole organization resembled that of a factory, and it was expected that the peasants would develop the factory workers' outlook and become one with them. But the peasants did not like them and so they never developed: in 1938 only about 10 per cent of the cultivated land was worked as State farms, and they were used for special purposes. A completely different type of farm was set up, on the basis of the old *Mir*. The first were communes in which the whole body of workers was responsible for the full maintenance of each individual family; but this did not answer. The *artel* organization was therefore adopted: another old Russian method which has no English equivalent. In this the workers feed and house themselves but the produce belongs to them, and after all outgoings have been met the balance is distributed according to the work done. The workers are paid in actual produce: mostly grain, potatoes, and vegetables, these being the main constituents of the peasants' dietary; usually also there is hay for the workers' animals, and a small amount of cash. This method after suitable modification proved much more acceptable, and by 1939 a very large part of the cultivated land of the U.S.S.R. was farmed in this way.

The farms were called 'Collectives'. All the cultivated land in the village, whatever its previous ownership, was thrown into one big farm: it might be 1,000–4,000 acres or more, but was not usually unmanageable in size. All the peasants of the village could come into the group, but preference was given to the so-called 'poor peasants'. The plan of production was until just before the War sent from headquarters: it had been discussed during its development, but once settled, it could not be further discussed. The workers elected a committee to carry it out and to allocate the tasks to the different people; the chairman, however, was not freely elected as he had to be accepted by the Party and the Government; he often came from outside and did not usually stay long. The Party always insisted on keeping its hold on the farms, and it had its representative, who was quite independent of the committee.

Payment was always by the piece; a certain job of work was called a "labour day", and when a man had done this he was credited with one day's work. Not infrequently about two hundred would be done during the year, but specially good workers would put in many more. The worker could eat his share of the produce or sell it to the farm, the Co-operative or in the peasant market.

The workers' share of the produce varied with the yields and the outgoings. The Government's share has varied. For some time prior to 1939 it was a fixed amount per acre of winter grain sown, and of

* Substance of a lecture at the Central Council for Health Education Summer School held in London during August.

spring grain ordered to be sown, also a fixed quantity of milk and meat per animal kept. A small price was paid, much below the market price. In 1939 more latitude in planning was allowed so long as the stipulated Government share was duly delivered. As this was fixed while yields were variable it is impossible to state any definite percentage; but an average of a number would lie between 15 to 20 per cent. Then the machine tractor station, the Government organization that hired out the tractors, combines and other big tackle and supplied the drivers had to be paid: this might take another 15 per cent. Seed for next season and fodder for winter had to be set aside: this also might amount to about 15 per cent. Insurance, administration, sick and needy people, maintenance, capital developments, and other farm overheads had also to be provided for. One way and another, more than half the produce would go, and the workers' share might be 40 per cent or less.

A great change in the system, and in the peasants' attitude to it, came when the Constitution of 1936 gave the collective farms the use of their land for ever, and also gave each member the use of his cottage and its garden and a holding varying from ½ acre to 2½ acres on which he could keep such animals as he and his family could look after. So popular were these holdings that by 1939 much of the peasants' time was spent on them and a large proportion of the livestock of the U.S.S.R. was their private property. So decrees went forth that they must put in a minimum of a hundred days per annum on the farm; this number has since been raised.

There is little doubt that when peace returns this modified system will be able to provide the U.S.S.R. with the food needed for a rising standard of life. The theoretical objection still remains: the peasants are not employees and do not come under the labour code: they have, for example, no trade union and are ineligible for old-age pensions. 'Peasant-mindedness' still continues and they are not one class with the factory workers. But so many theoretical difficulties have been brushed aside in the U.S.S.R. for a realistic solution that we may expect this also will disappear and the system will become wholly acceptable.

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# PREPARATION OF A GIANT STRAIN OF *Torulopsis utilis*

By DR. A. C. THAYSEN and MURIEL MORRIS
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IN the microbiological synthesis of protein it has been observed that the complete separation of the yeast produced from the fermented wort offers certain difficulties when *Torulopsis utilis* is used as the active organism. These difficulties are due primarily to the considerable variation in cell-size of the organism, some cells being as small as $3\,\mu \times 5\,\mu$, or less than half the size of the average cell of this organism. Moreover, these smaller cells appear to be particularly numerous towards the end of the fermentation period, when they represent quite an appreciable percentage of the total. Since they remain more tenaciously suspended in the fermented wort than the larger cells, they easily cause a drop in yield when the yeast is separated in the centrifuge or the filter press, through the filter cloth of which they pass more readily than the larger cells. It was felt that if a method could be devised by which the size of the cells of *Torulopsis utilis* could be permanently increased, the manufacturing difficulties referred to might be largely overcome.

It might be anticipated that the most likely way of producing a strain of *Torulopsis utilis* with cells larger than the standard would be by treating the original strain with colchicine, but Blakslee's[1] and Richards'[2] attempts at influencing the nuclear divisions of various mycelium-producing fungi, bacteria and strains of *Saccharomyces cerevisiæ* in this way were unfortunately not encouraging, as they gave entirely negative results. There seemed little hope for expecting, therefore, that success might be achieved with *Torulopsis utilis*. However, it was felt that an attempt should be made to determine the effect of colchicine on *Torulopsis utilis*, if for no other purpose than to confirm that Richards' observations on strains of Saccharomyces apply equally to the non-spore-forming *Torulopsis utilis* type of 'yeast'.

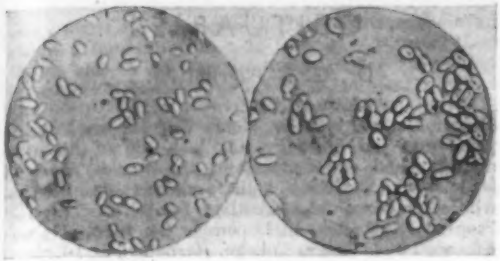
To do so a set of experiments was carried out in which increasing quantities of colchicine, from 1 mgm. to 100 mgm., were added to ordinary wort agar which was poured into Petri dishes, each seeded with about a hundred cells of a fresh culture of *Torulopsis utilis*. The various plates, as well as one or two control plates of ordinary wort agar without colchicine addition, were incubated at 30° C. and the time noted for colonies to appear. In addition, the number of colonies on the plates were counted and the rate at which growth progressed noted.

Even at colchicine concentrations of 100 mgm. per 10 ml. wort agar, no influence could be detected of an action of the alkaloid on the growth of *Torulopsis utilis*, and measurements taken of the size of the cells differed in no way from those of cells of the control strain grown on ordinary wort agar. The observations of Blakslee and Richards therefore apply also to *Torulopsis utilis*, the nuclear functions of which, whatever they may be, remain unaffected by colchicine.

Recently attention has been directed by Bauch[3] to substances other than colchicine which influence mitosis and may give rise to the production of giant cells. Among these substances is α-naphthylamine.

The effect of this substance on the cells of *Torulopsis utilis* was studied by us in a series of experiments in which increasing amounts of this chemical were added to wort agar, afterwards seeded with *Torulopsis utilis* cells in numbers to yield approximately a hundred colonies per test culture. Starting with 1 mgm., the concentration of α-naphthylamine was gradually increased to 60 mgm. per 10 ml. of wort agar. It was observed that quantities up to 20 mgm. of α-naphthylamine had no influence on the numbers of colonies appearing on the test plates after incubation at 30° C., nor could any change be seen in the size of the cells produced. On the plates containing 25 mgm. and 30 mgm. of the chemical, only 30 per cent of the seeded cells gave rise to colonies, while the plate containing 40 mgm. of α-naphthylamine allowed only 1 per cent of the inoculated cells to grow. The plate with 50 mgm. of α-naphthylamine remained sterile. It was noticeable that the shape of the cells on the plates with high concentrations of α-naphthylamine had changed from the normal egg-shape to spherical. The volume, however, had not been increased.

A single cell of the spherical type was removed by the micromanipulator and grown in liquid wort at 30° C. The ensuing culture was found to be



(a) (b)

(a) CELL OF STANDARD STRAIN OF *Torulopsis utilis*. × 440.
(b) CELL OF CAMPHOR-GROWN STRAIN OF *Torulopsis utilis*. × 440.

composed of normally-shaped cells. The effect of α-naphthylamine, therefore, had been transient and unable to affect the nuclear functions of the organism exposed to it.

Prior to his reference to α-naphthylamine as a mitosis toxin, Bauch[4] had mentioned, in passing, that camphor affected mitotic changes in brewer's yeast and other fungi, resulting in the production of giant cells. Without giving details of his procedure, Bauch reported that the action of camphor resulted in the doubling of the chromosome number of the cells affected.

It was decided to study the effect of camphor on *Torulopsis utilis* on the lines previously used for colchicine and α-naphthylamine. The amount of camphor added to plates each containing 10 ml. of wort agar ranged from 5 mgm. to 50 mgm. Each of the plates was seeded with about a hundred cells of a fresh culture of *Torulopsis utilis* grown on wort agar, and incubated at 30° C.

It was found that with camphor additions of 20 mgm. or less, growth of *Torulopsis utilis* proceeded undisturbed at the temperature chosen, and there was nothing to indicate that the size of the cells had been affected. At camphor concentrations of between 25 mgm. and 30 mgm., the growth of the inoculated cells into colonies was impeded at first and could not be detected macroscopically until two days after the formation of visible colonies on the control plates. The number of colonies eventually appearing on the plates containing 25 mgm. of camphor was not noticeably smaller than that on the controls, but on the plates containing 30 mgm. of camphor only a few of the seeded cells gave rise to macroscopically visible colonies. In these colonies marked changes had taken place in the size of the individual cells, and measurements revealed that the average size (from twenty separate determinations) had increased from $3{\cdot}8\,\mu \times 7\,\mu$ for the standard strain of *Torulopsis utilis* to $4{\cdot}8\,\mu \times 8{\cdot}9\,\mu$ for the cells of the strain grown on camphor. These dimensions would correspond with a difference in volume of $326\,\mu^3$; $318\,\mu^3$ being the volume of the cell of the standard strain and $644\,\mu^3$ that of the cells of the camphor-grown strain. The accompanying photographs illustrate the difference between the size of the cells of the two strains.

By means of a micromanipulator a single cell was isolated from a colony on the plate containing 30 mgm. of camphor and subcultured in ordinary wort agar. The resulting culture was catalogued as *Torulopsis utilis* var. *major*.

*Torulopsis utilis* var. *major* has been subcultured over a period exceeding one year and has retained unimpaired its most significant characteristic, the increased cell volume.

Attempts have been made to increase still further the volume of the cells of the new strain by growing it on wort agar containing camphor, but without success. It was noticed in these experiments that growth of the inoculated cells on the camphor medium was temporarily impeded when the camphor concentration reached 30 mgm. per 10 ml. wort agar, and that only a few of the seeded cells eventually grew into colonies. Beyond a concentration of 30 mgm. of camphor in 10 ml. of wort agar, no growth at all took place.

The size of the cells of the developing colonies did not differ from that of *Torulopsis utilis* var. *major* cells. It was concluded, therefore, that an increase in size beyond that already achieved was impossible and that in this respect *Torulopsis utilis* differed from that of the Saccharomyces strains studied by Bauch.

Having obtained a strain with cells considerably larger than those of the original *Torulopsis utilis*, the new type was submitted to various tests in order to determine its suitability for food yeast production.

In the first place the strain was compared with the standard culture of *Torulopsis utilis* in its ability to separate from the spent wort of a fermented molasses wort. It was found that both in the centrifuge and in the filter press the cells of *Torulopsis utilis* var. *major* could be more readily separated than the cells of the standard strain. It remained to be ascertained whether the new strain possessed the valuable properties, as regards protein and vitamin content, of the mother strain and would give as large yields of yeast per unit of carbohydrate consumed as the latter.

The results of a comparative examination of the two strains are given in the accompanying table.

| | *Torulopsis utilis* | *Torulopsis utilis* var. *major* |
|---|---|---|
| Size of cell | $3{\cdot}8\,\mu \times 7\,\mu$ | $4{\cdot}8\,\mu \times 8{\cdot}9\,\mu$ |
| Volume of cell | $318\,\mu^3$ | $644\,\mu^3$ |
| Yield of dry yeast on sugar fermented | 59–60 per cent | 59–62 per cent |
| Protein content of dry yeast | 55·3 per cent | 56·0 per cent |
| Phosphorus content of dry yeast | 1·8 per cent | 2·8 per cent |
| Aneurin content of dry yeast | 20 μ gm. per gm. | 20 μ gm. per gm. |
| Riboflavin content of dry yeast | 60 μ gm. per gm. | 60 μ gm. per gm. |
| Taste of dried yeast | Slightly meaty | Slightly meaty |
| Colour of dried yeast | Light buff | Light buff |
| Generation time under standard conditions of fermentation | 100–110 min. | 58–90 min. |
| Optimum temperature | 30° C. | 30° C. |

Thus in every one of the above-mentioned characters, except those of size and generation time and possibly in phosphorus content, the two strains were identical.

The significance of the shorter generation time will be referred to in greater detail in a subsequent report, and it may therefore suffice to state here that the shorter generation time should offer advantages in speeding up the output of yeast from any given capacity of fermentation plant.

## Discussion

The experiments reported above have shown that Bauch's claims to have produced giant cells from various Saccharomyces species by exposure to camphor vapours applies equally—though to a limited extent—to at least one Torulopsis species.

The increase in size of cells of *Torulopsis utilis* is limited to a doubling of their volume. Repeated application of the camphor technique leads to no further change.

The doubling of the cell volume has been found to be permanent, even in cultures of the new strain which have not had contact with camphor for hundreds of generations, an observation which proves that very deep-seated changes have resulted from the original exposure.

It has not been possible, so far, to determine whether the increase in cell volume can be correlated with an increase in nuclear substance. Further work in this direction is contemplated. In this connexion it may be significant that in one experiment it was observed that the percentage of nucleic acid extractable from a given weight of cells of the new strain was considerably greater than that obtained from the same weight of cells of the standard *Torulopsis utilis* strain.

It is of interest also to record that the cells of *Torulopsis utilis* var. *major* show a greater tendency to autolyse than the cells of the standard strain. In this connexion, therefore, the new variety behaves like the thymus cells studied by Dustin and his collaborators under the influence of karyoklastic toxins, that is, toxins which among their number include colchicine but not camphor. Chodkowski[6] has given an interesting account of Dustin's theory of the functioning of karyoklastic toxins.

With the knowledge that camphor in certain concentrations is capable of producing deep-seated changes in the cell-volume of *Torulopsis utilis*, it was thought of interest to find out whether other bicyclic terpenes would have a similar effect. So far, it has been possible to show that two further members of the camphor system, borneol and bornyl acetate, and one of a different terpene grouping, camphene, are capable of inducing what appears to be the same changes in cell volume as camphor itself. The significance of this observation is being followed up.


## Summary

Under the influence of camphor, the cells of *Torulopsis utilis* undergo deep-seated changes which result in the permanent increase in their volume. By such influence a new strain of *Torulopsis utilis* has been produced, and designated *Torulopsis utilis* var. *major*, which in its biochemical properties is identical with that of the mother strain, though it differs from it in certain mechanical characteristics and physiological behaviour. Further, it has been found that other bicyclic terpenes than camphor may react on *Torulopsis utilis* in the same manner as camphor itself. Colchicine and α-naphthylamine were found to be incapable of increasing the cell volume of *Torulopsis utilis*.


We are grateful to Dr. Harriet Chick of the Lister Institute of Preventive Medicine for the assay of the aneurin and riboflavin content of the two strains of *Torulopsis utilis*.

The work described above was carried out as part of the programme of the Chemistry Research Board, and is published by permission of the Department of Scientific and Industrial Research.

[1] Blakslee, A. F., *Science*, **89**, suppl. 28.4, p. 10 (1937).
[2] Richards, O. W., *J. Bact.*, **36**, 187 (1938).
[3] Bauch, R., *Naturwiss.*, **29**, 503 (1941).
[4] Bauch, R., *Naturwiss.*, **29**, 673 (1941).
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# OBITUARIES

## Dr. G. E. Pilgrim, F.R.S.

WITH the death on September 15, at Upton near Didcot, Berkshire, of Dr. Henry Guy Ellcock Pilgrim, vertebrate palæontology has lost one of its most distinguished exponents, and the world's greatest authority on the rich Siwalik fauna of India. Pilgrim, who came of an old Barbadian family, was born at Stepney, Barbados, on December 24, 1874. He was educated at Harrison College, Barbados, and University College, London (D.Sc., 1908); he was appointed to the Geological Survey of India in 1902, from which he retired in 1930, having been a superintendent since 1920. He then became a member of the supernumerary staff of the Department of Geology, British Museum (Natural History). He was elected a corresponding member of the Palæontological Society of America (1925), a fellow of the Asiatic Society of Bengal (1925), and, very belatedly, a fellow of the Royal Society (1943). He was president of the Geological Section of the Indian Science Congress in 1925. During the War of 1914–18 he was attached as 2nd lieutenant to the 125th Napier's Rifles, and received war medals for service in Mesopotamia and Persia, 1916–19.

Pilgrim's work with the Geological Survey of India can be divided into two main sections: as a geologist, and as a palæontologist. His most important stratigraphical work was divided between two problems, namely, (1) the survey of portions of Persia and Arabia; and (2) the Siwaliks and other Tertiary freshwater deposits of North-Western India, including Baluchistan.

The Persian Gulf work was done in two visits, and has been described in two *Memoirs of the Geological Survey of India* (**34**, Pt. 4; 1908: and **48**, Pt. 2; 1924). In these two memoirs he described the geology of much country that had not previously been visited by a geologist, incorporated the work of earlier workers where this was of value, and laid down the succession of formations in Persia from Pre-Cambrian to Recent, introducing a nomenclature that has in the main been adopted by later workers.

Pilgrim was not only the first geologist but also the first European to visit parts of Trucial Oman in Arabia. He was also the first geologist to visit Bahrein Island in the Persian Gulf, which he mapped. He showed that the structure was that of a dome, and this led later to boring for oil, and a flourishing industry is now established in Bahrein.

Still more important scientifically is Pilgrim's geological work in India. The Siwalik formation, so famous for its fossil vertebrates, had not been previously subdivided, except into a lower apparently unfossiliferous section and an upper fossiliferous section. Strata 15,000–20,000 ft. thick had all been lumped together, and the fossils derived from several stages all mixed together; these fossils had been described merely as zoological specimens without any knowledge of their relative ages, except such as could be surmised by comparison with fossils elsewhere. To Pilgrim belongs the distinction that he reduced this muddle to order. He showed that there are three separate fossiliferous divisions to the Siwaliks, each with its characteristic vertebrate fossils, and in his "Preliminary Note on a Revised Classification of the Tertiary Freshwater Deposits of India" (*Rec. Geol. Surv. India*, **40**; 1910), he sorts out two hundred species of Indian vertebrates among his three

divisions of the Siwaliks and the underlying Nari beds, and assigns ages in terms of European nomenclature ranging from Aquitanian to Pliocene. Fifty of these species are of his own discovery. In a later paper, "Correlation of the Siwaliks with Mammal Horizons of Europe" (*Rec. Geol. Surv. India*, **43**; 1913), he succeeds in splitting up the Tertiary freshwater strata of India and Burma into no less than thirteen horizons with their characteristic fossils, ranging from the Gaj below to the Boulder Conglomerate at the top of the Siwaliks. He shows the European equivalent of each horizon, and also the equivalence of the freshwater strata with the marine Tertiary beds of India. His correlation has been of immense use to all later workers on the Tertiaries of India.

Pilgrim also made an expedition to Bhutan, and wrote a joint memoir, with Mr. W. D. West, on the geology of a portion of the Simla Hills.

With the help of the late Mr. Vinayak Rao, Pilgrim added largely to the already large collections of Siwalik vertebrate fossils in the Geological Museum in Calcutta, and he thus had at his disposal an immense mass of material, partly already described in the past by Lydekker and partly new. To this material Pilgrim devoted all available time while in the Indian service, work that he continued in London at the Natural History Museum after his retirement. The total result is an impressive mass of fine memoirs in the *Palaeontologica Indica* descriptive of various groups of Indian vertebrates, of which one may list in chronological order the Giraffidæ of India (1911), the Vertebrata of the Gaj of the Bugti Hills and the Punjab (1912), the Perissodactyla of the Burma Eocene (1925), the Suidæ of India (1926), the Artiodactyla of Burma (1928), the Carnivora of India (1932), and finally the Bovidæ of India (1939). Separate mention may be made of Pilgrim's discoveries of fossil primates in the Siwaliks, comprising no less than five new species and two new genera. In his view Sivapithecus, one of these latter, was, when he wrote (1915), the closest anthropoid phylogenetically to man, with the possible exception of Pithecanthropus and Eoanthropus.

The preparation of this note has been a sad task for me, for Pilgrim, the late James Malcolm Maclaren and I travelled out to Calcutta together in 1902, on the P. and O. *Coromandel*, to join the Geological Survey of India.

L. L. FERMOR.

## Prof. H. G. Denham

THE death, which occurred on February 15, 1943, of Prof. Henry George Denham, professor of chemistry in, and rector of, Canterbury University College, Christchurch, New Zealand, and chairman of the New Zealand Council of Scientific and Industrial Research, has deprived the University of New Zealand of a distinguished teacher, administrator and investigator, and both the Dominion and the British Empire of a man who had done eminent public service in vigorously fostering the advancement of pure and applied science in his native country.

He was born in Christchurch on July 14, 1880, and received his early education at Sydenham School, whence he proceeded with a scholarship to the Boys' High School. Having completed his school education, he adopted school teaching as a profession, but while still engaged on this work entered Canterbury College as a student in 1901. Here he decided to study chemistry as his main subject when Dr. W. P. Evans was appointed to the chair of chemistry in 1903. He won the Chemistry Exhibition and graduated B.A. in 1904 and M.A. with first-class honours in chemistry in 1905. Having carried out an investigation on the temperature of combustion of methane in the presence of palladiumized asbestos, he obtained the M.Sc. degree and won the 1851 Exhibition Science Research Scholarship in 1906. In the same year I had the good fortune to welcome him as a research student in the Muspratt Laboratory of Physical and Electro-Chemistry, University of Liverpool. Denham's cheery and good-natured personality and his keenness and enthusiasm for research in physical chemistry were a great source of strength to the newly opened laboratory, whither a few years later were to come three other very able young New Zealand investigators—Prideaux, Farrow and Stubbs.

Denham proved to be an exceptionally gifted research student. His first work was the determination of the degrees of hydrolysis of salts in aqueous solution by means of the hydrogen electrode. This novel and pioneering piece of electrometric research led Denham on to two other very interesting lines of investigation. Having found that in the presence of the hydrogen electrode anomalous values for the hydrogen ion concentration in solutions of lead salts were obtained—results which could be explained only by the assumption of a partial reduction of bivalent to *univalent* lead ions at the surface of the platinum-hydrogen electrode—he joined forces with A. J. Allmand, then a research student in my laboratory. By means of an automatic thermo-circulation apparatus they caused a solution, say, of lead acetate, to pass constantly upwards through a hot steam-jacketed column containing metallic lead and then downwards through a cooled column (of the same solution). In this way they found that metallic lead crystallized out from the solution in the cooler part, a result which could be best explained by the reversible equilibrium

$$Pb^{++} + Pb \underset{\text{cooling}}{\overset{\text{heating}}{\rightleftharpoons}} 2Pb^{+},$$

similar to that which occurs in the case of copper and gold salts. Encouraged by this remarkable result, Denham then went on alone to apply the same method to other salts and demonstrated the existence in aqueous solution of a univalent cadmium ion, a 'subvalent' thallium ion ($Tl_2^+$) and a bivalent bismuth ion. In the electrometric investigation of the hydrolysis of salts of zinc, magnesium, thorium, cerium, nickel and cobalt, Denham found that very irregular and fluctuating results were obtained. These he explained by the assumption of the existence of a microheterogeneous system, that is, the presence of colloidally dispersed hydroxides or basic salts in the solution. A closer examination of these 'anomalies' led to the publication of an interesting paper. In connexion with this work it may be mentioned that Kolthoff and Kameda in 1928 explained the anomalous results as due to the adsorption of metal cations on the platinum black. The equivalent amount of hydrogen ions liberated in the solution upsets the hydrolysis measurement. The work on the hydrolysis of salts was completed by an electrometric determination (with the hydrogen electrode) of the degrees of hydrolysis in aqueous solution of the blue and green chromic sulphates.

Denham's last piece of work in my laboratory dealt with the formation of 'autocomplexes' (anionic complexes) in solutions of cupric chloride, cupric bromide

and cobalt bromide, in which an ionic transport method was employed. For his excellent research work he was awarded the D.Sc. degree by the University of Liverpool. Denham then went to continue his researches in Germany, and having arrived in the laboratory of Prof. Bredig at the University of Heidelberg he informed Bredig that he wished to work for the Ph.D. degree of that University but could only spend about a year on the job. Prof. Bredig was astonished, said that such a thing was very difficult if not impossible—but he could have a shot at it if he wished! Little did he realize Denham's tremendous powers of concentration and hard work, not to mention his great insight and skill as an investigator. The result was Denham did so well that he got his Heidelberg Ph.D. in the year. His subject of investigation was a quantitative study of the reversible catalytic reduction of titanic salts by hydrogen gas (in presence of platinum black). It formed one of Bredig's great series of studies in heterogeneous catalysis.

With a record of six published papers and the research degrees of two European universities (a pretty good record for 3½ years work), Denham returned to New Zealand in 1910 and acted for a time as research student and honorary lecturer at Canterbury College. Then in 1912 he obtained a post as lecturer in chemistry under Prof. B. D. Steele at Brisbane (University of Queensland), where he was appointed head of the Chemistry Department and acting-professor during the absence of Prof. Steele on war-work in England, obtaining the title of assistant-professor at the end of the War.

In 1921 Denham published his useful text-book of inorganic chemistry, and in the same year was appointed professor of inorganic chemistry at the University of Cape Town, remaining there only two years, for in 1923 he was offered and accepted the succession to the chair of chemistry at Canterbury College, Christchurch—a post which he still occupied at the time of his death. From 1941 he held also the high office of rector of the College. During his twenty years as professor, Denham proved himself to be a very active and excellent university teacher and administrator, the much-loved father of his students, and a wise, energetic and forward-looking member of the academic body. He was a member of the Academic Board of the University from its inception in 1927, and a representative of that Board on the University Senate from 1935. Apart from his great work in University and College affairs, Denham was very active in fostering and promoting the advancement and application of science in New Zealand. He was a fellow of the Royal Institute of Chemistry of Great Britain and Ireland, an original fellow of both the Australian Chemical Institute and the New Zealand Institute of Chemistry, and a fellow of the Royal Society of New Zealand and of the New Zealand and Australian Association for the Advancement of Science. Of the latter body he was president of Section B (Chemistry) for the Hobart meeting in 1928, and Liversidge Lecturer for the Canberra meeting in 1939.

Denham took a very active and important part in the promotion and development of scientific control and research in connexion with both primary and secondary industries in New Zealand. Thus he was a member of the New Zealand Council of Scientific and Industrial Research from its establishment in 1926, becoming chairman in 1934. He was active in the foundation of the Wheat Research Institute in 1927 and chairman of its committee from the start. Denham's interest in the successful promotion of agricultural science and practice can be realized when it is stated that he was a member of the Board of Governors of Canterbury Agricultural College during 1928–41 and its chairman during 1932–38; a member of Council of the New Zealand School of Agriculture from its foundation in 1937 until 1941, and a member of the committees of the Dairy Research Institute and the Wool Manufacturers' Association.

During his stay in Brisbane and Cape Town, Denham published a number of papers on complexes in solutions of copper and cobalt salts and on the existence and preparation of the suboxides and subsalts of lead, cadmium and bismuth. Some doubt has been cast on the existence of certain of these suboxides and subhalides by the later work of Hollens and Spencer (1934), using magnetic susceptibility measurements, and by that of Hedger and Terrey (1936) using X-ray methods. Some of the substances in question were prepared by methods which Denham's work had also shown to be doubtful.

During his busy years as professor at Christchurch, Denham never lost his interest in research, and in collaboration with senior students published a number of papers on salt hydrolysis and on the ternary systems zinc oxide – nitric acid – water and lead oxide – nitrogen pentoxide – water.

The coming of the War brought new and heavy burdens. He threw himself fully into the great war effort of New Zealand, but there seems little doubt that this extra strain was too much for a man who had never spared himself in his devoted services to his students, the University, the community and science. Fortunately, he lived long enough to know of the great honour that was coming to him, namely, honorary membership of the Society of Chemical Industry.

As one of his old teachers, I have always had the highest regard and affection for him, and count it a special piece of good fortune for myself that I was able to help him at an early stage in his career. He was a great son of his native land, and a very fine example of a man who devoted himself wholeheartedly not only to the advancement of science and sound learning but also to the promotion of the health, happiness and prosperity of his fellow countrymen by the means which science can provide.

F. G. DONNAN.

## Sir Michael Sadler, K.C.S.I., C.B.

THE death of Sir Michael Sadler removes from the world of education an elder statesman universally honoured for his achievement and almost as widely trusted for his wisdom. He was never, as too many of our educationists are apt to be, merely the brilliant amateur in the field, or the politician in disguise. Both these parts he could have played to perfection, if he had so chosen, for he had the gift of persuasive eloquence and great personal charm. At Oxford he became president of the Union in his second year, but made no mistake about his first classes in the Schools. Then in 1895 he settled down to the Oxford University Extension work, shaping in a very short time the main lines which it has since followed. He passed on almost at once to spend eight years as director of special inquiries and reports at the Board of Education, and used the opportunity to conduct a thorough study of what was being done outside Great Britain, particularly in Prussia and generally

in Germany. It was a period in which he not only extended his own knowledge far and deep, but also produced a series of vitalizing documents which gave confidence and purpose to the educational movement which began in 1902. In that year it can be safely asserted that no Englishman knew more about education at all its stages in all the countries that mattered than Sadler, and certainly there was no one more capable of expressing what he knew. It was natural that his knowledge and powers should be freely used. On one hand he became for a brief period professor of the history and administration of education at Manchester, and then vice-chancellor of Leeds; on the other, he found time to plan the secondary and higher education of Sheffield, Liverpool, Birkenhead, Huddersfield, Exeter, Newcastle-upon-Tyne, Derbyshire and Hampshire. This series of signal public services culminated in his presidency of the Calcutta University Commission and his monumental report on Indian education. His long apprenticeship had borne abundant fruit, and all of it came to maturity. Later, he returned to his old University as master of University College, continuing to be until his retirement and after it a source of inspiration and life in the many causes to which he laid his hand: in the University and in the City, of which he became a freeman; in the Oxford Preservation Society; and in all movements for the encouragement and better understanding of modern art and promising artists.

He could deliver a formal oration of perfect classical form, and equally could speak with eloquence and fire on the spur of the moment in a company large or small. He had the gift of throwing his entire self into whatever engaged his interest, and partly because of this he won the devotion and admiration of many young people. He radiated friendliness, and it was not for nothing that Leeds during his vice-chancellorship was spoken of as "the friendliest in the country". He attracted youth also because he was little interested in what was already established and conventional, but was ever looking for promise and the movement of the future. It is significant of this quality in him that at Headington his fine Gainsboroughs were not given pride of place, but were kept in the shade by his remarkable collection of modern examples, which much resembled the wheat and the tares alike growing together for the harvest; and it must be confessed that he liked to shock convention to the extent of advancing paradoxes in which he did not entirely believe himself. It has been said that the Greeks were always children, and Sadler in the same way kept something of the eternal boy. He told a select gathering of heads of houses at Oxford that in a generation Oxford and Cambridge would be moss-grown relics of the past, and the intellectual life of the country would have passed to Leeds, Manchester and Birmingham. He blandly advocated a by-pass to bisect Christ Church meadows, partly because he liked by-passes as being strong, broad and direct, like himself, and partly he wanted to observe the shock with which Oxford would react to this assault on one of its most treasured beauties.

He had a happier life than is given to most: he has left us the record of a great and lovable man.

CYRIL NORWOOD.

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WE regret to announce the following deaths:

Prof. Leon Asher, emeritus professor of physiology in the University of Berne, on August 8, aged seventy-eight years.

Prof. H. L. Lebesque, For.Mem.R.S., professor of mathematics in the Collège de France, during 1941, aged sixty-eight.

Prof. Einar Lönnberg, the well-known Swedish zoologist, on October 21.

Mr. Cecil Rowntree, the distinguished surgeon and authority on cancer treatment, on October 14, aged sixty-three.

Sir Aurel Stein, K.C.I.E., F.B.A., the authority on Central Asian antiquities, on October 26, aged eighty.

Mr. W. P. Westell, formerly curator of the Letchworth Museum and well-known lecturer and writer on natural history, on November 1, aged sixty-eight.

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# NEWS and VIEWS

## Woodwardian Chair at Cambridge: Lieut.-Colonel W. B. R. King, O.B.E., M.C.

LIEUT.-COLONEL W. B. R. KING has been appointed Woodwardian professor of geology in the University of Cambridge. He has the unique distinction of having been the chief representative of British geology directly employed as a geologist in both world wars. He won two awards on the Western Front: an O.B.E. for geological services in the War of 1914–18, and an M.C. for non-geological actions connected with the evacuation of the British Army from France in 1940. In peace, Colonel King was a member of the Geological Survey of Great Britain from 1912 until his appointment as Prof. Marr's assistant at Cambridge in 1920. Eleven years later he was elected to the Yates-Goldsmid chair of geology at University College, London.

Colonel King's publications are an index to his wide interests. Among them we find contributions to Palæozoic palæontology and stratigraphy, largely drawn from the north of England and Wales, but including also descriptions of fossils from the Middle East and India; gleanings from his war experience of the Mesozoic and Tertiary formations of the Continent; interpretations of North of England scenery; and a co-operative excursion into the marches of geology and archæology, so well represented in the Pleistocene of the Thames Valley. Colonel King's past experience on the Geological Survey has given a special character to his open-air teaching of his subject. In another direction, he will be remembered as a popular secretary of the Geological Society.

## New Master of Birkbeck College: Prof. H. Gordon Jackson

WITH the appointment to the mastership of Birkbeck College, London, of Prof. H. Gordon Jackson, who has been head of the Zoology Department there since 1921 and professor since 1928, the Governors seem to have followed a similar course as towards the end of the War of 1914–18, when the late Dr. Senter was appointed to that position. Thus during the important period of reconstruction which the College looks forward to after the War, there will

be in charge one who is familiar with the rather special conditions which obtain there. To zoologists Prof. Jackson is best known for his numerous papers on the systematics of the terrestrial Isopod Crustacea and on the comparative anatomy of the Isopod head; but his colleagues are familiar, too, with the imperturbable good humour, the careful planning and the absolute fairness with which he has presided over numerous bodies in his College and University, while large numbers of former students recall with great enjoyment the lucidity and wit of his lectures, and his uncanny knack of selecting precisely the most apt metaphor or simile for driving home a point of difficulty. In view of the damage sustained by the College during the raids of 1940–41 and the part which Birkbeck College is bound to play in University education after the War, the transfer of the College to the Bloomsbury site is one of its most urgent problems. Prof. Jackson's many high qualities will, we feel, ensure an early solution.

## Tercentenary of John Bainbridge

WHEN Sir Henry Savile (1549–1622), while holding the post of warden of Merton College, Oxford, founded the Savilian professorships of geometry and astronomy at Oxford in 1619, the first of these was given to Henry Briggs (1561–1630), who had held the chair of geometry at Gresham College, London, while to the second was appointed John Bainbridge, a London physician who had just published a description of a comet observed in November 1618. Bainbridge on his appointment was thirty-seven, and he continued to hold his chair until his death on November 3, 1643. Born at Ashby-de-la-Zouche, he had studied at Emmanuel College, Cambridge, and had qualified in medicine. While teaching and practising he devoted his leisure to mathematics and astronomy. Removing to Oxford in 1620, he continued his study of the writings of the Greeks and Arabs, and though he published but little, he left a considerable number of manuscripts. These he bequeathed to his friend, the learned but unfortunate Archbishop James Ussher (1581–1656), whose library, after various vicissitudes, passed to Trinity College, Dublin. Bainbridge died at his house opposite Merton College, and after an oration by William Strode, his body was laid beside that of Briggs in Merton College Chapel.

## Aeronautical Medals

THE Royal Aeronautical Society has recently acquired, through the generosity of an anonymous donor, a remarkable collection of more than three hundred aeronautical medals, dating from 1714 to 1941. The medals are a veritable history of aeronautics, struck on the occasion of some aeronautical event. Three of the early medals were struck in 1783 to commemorate the first ascent of the Montgolfier Brothers in a hot-air balloon; two others show the first ascent of Lunardi from London in 1784; another the first Dutch aeronaut to ascend, from Amsterdam, in 1806. James Sadler, the first Englishman to make an ascent, is commemorated in a medal dated 1811. A silver medal of 1851 shows the ascent of three balloonists each on a horse! There are many examples of the Siege of Paris medals of 1870, Giffard's ascents and others. A bronze medal of 1896 shows the Andrée polar balloon, and several silver ones of 1901 Santos Dumont's dirigible. Coming to later days, there is a medal of 1909 commemorating the award of the Congress Medal to the brothers Wright; medals of various Zeppelins, Parseval, the *R.*101 and other dirigibles; medals commemorating Bleriot's cross-Channel flights, 1909; the flights of Paulhan (London–Manchester, 1910); Chavez (crossing the Alps, 1910); Lindbergh (trans-Atlantic flight, 1927); Hinkler (London to Australia, 16 days, 1928); Kohl, Hunefeld and Fitzmaurice (Ireland to America, first east–west flight, 1928); and Prof. Picard and Dr. Kipfer (first stratosphere ascent, 1931).

## Collaboration in Fuel Research

THE Standing Consultative Conference on Fuel Research, which has been constituted by the Department of Scientific and Industrial Research to promote collaboration among the various research associations or equivalent organizations engaged on fuel research, and between them and the Department's Fuel Research Organisation, had a preliminary meeting on October 21 at which representatives of the Ministry of Fuel and Power, the British Coal Utilisation Research Association, the British Electrical and Allied Industries Research Association, the British Refractories Research Association, the Gas Research Board, British Iron and Steel Federation (Industrial Research Council), and British Hard Coke Research Association were present. In his opening remarks Sir Edward Appleton, who presided, briefly described the objects which the Department had in view in setting up the Conference, and emphasized that membership is voluntary and at the invitation of the Department. The Conference is intended to provide a convenient means whereby the research organizations may keep in close touch with each other, and assist each other by interchange of information and by friendly discussion. Members of the Conference described briefly the aims and scope of their organizations and then discussed arrangements for the setting up of a central body to undertake the preparation and publication of abstracts of current literature relating to fuel and the maintenance of a register of translations. It was decided that the next meeting should be held early in January 1944, when the fuel research programmes of the member organizations would be considered by the Conference.

## Application of Biology to Agriculture

DR. HUBERT MARTIN'S presidential address to the Association of Applied Biologists, delivered on February 12, 1943, which has now appeared in the *Annals of Applied Biology*, pays tribute to the work of the Biology War Committee and expresses the view that the provincial advisers in the biological subjects may soon be expected to assert their proper and powerful influence on the activities of the War Agricultural Executive Committees. Discussing the official recognition of proprietary pest control products, which has been brought into fresh prominence through the participation of the advisory services in the "Grow-more" campaign, Dr. Martin outlined the negotiations between the Association and the British Mycological Society, the Ministry of Agriculture and the Association of British Insecticide Manufacturers which had led to the scheme announced in October for a joint panel to give the requisite guidance to the advisory committee. The further growth of the scheme, which will not admit products of wholly secret composition and which includes no testing

organization, is dependent on the goodwill of those concerned in its operation, and Dr. Martin regretted that no provision was made for the direct representation of the Association of Applied Biologists or of the advisory services on the organization.

In Dr. Martin's opinion, personal contact is the royal road to the full application of biology to agriculture, but for the grower the printed or written word is the best form of memorandum. After citing instances of the failure of the results of research to be transmitted in proper perspective to the grower, Dr. Martin commended to the Agricultural Improvement Council the appointment of a corps of intelligence or public relations officers. Such officers should be journalists acquainted with both practical and scientific aspects, able to translate research into vivid workaday English, wise enough to avoid sensationalism and to seek expert advice on their scripts before publication. To foster mutual confidence they should move freely among growers, advisory officers and research workers.

## Responsibilities of Scientific Societies

THE latter part of Dr. Martin's address is devoted to the wider questions of the post-war responsibilities of the Association of Applied Biologists, particularly in presenting a common front with other scientific men to guide the application of science. Science, he said, must protect itself from exploitation and must also accept responsibility not only in safeguarding humanity against such misuse, but also in ensuring that mankind shall profit to the full by the impact of science. In furtherance of this, Dr. Martin suggested subdivision of the Society not on a geographical but on a subject basis, each subject group dealing with the applied aspects of one particular branch of biology. The subject groups would then serve to link together all biological sciences in an organization capable of exerting a unified pressure, yet bound not by rigid rule or order but by common interests and responsibilities. He believes such a method would provide for collaboration with the academic societies without necessitating the segregation of non-pathological members of the Association in accordance with W. C. Moore's suggestion to the British Mycological Society. Moreover, it could also be made to serve the unification of science by counterbalancing the economic tendency of the larger publishing societies to lose contact.

Discussing further the formation of a united scientific front, Dr. Martin believes that this is more likely to be achieved with the publishing societies rather than the professional societies as the basis for its organization. He visualizes a Science Council on which the sciences would be represented by election from the publishing societies. Such a Council should, he urged, set up a main committee with sub-committees in the different sciences, which, with philological representation, would extend the work on nomenclature to that of terminology at its broadest. Its task would be to guide the evolution of language and to add to its precision as an instrument of science. He pleaded also for a simplification of spelling, but even more important than a common language is the task of training humanity in those principles to which science itself is dedicated. The primary task of the Commonwealth of Science is to convert mankind to the methods and ethics of science; to train the young in the discipline of science; to instil into statesmen and politicians the spirit of science and to show commerce that there is more profit in the full application of science than its exploitation. This would involve a fundamental change in the status of the sciences in education and a change in the attitude of the scientific hierarchy towards the political responsibilities of science. He thinks that the danger of fundamental science becoming neglected is illusory, but he deplored any industrial pressure which restrains publication of knowledge. Patent laws encouraging such restriction should be repealed. The danger of falling from scientific grace is no reason for monastic seclusion and for refusal to participate in building up a science front strong enough to withstand any form of pressure, or to correct political and industrial offences against scientific interests and principles.

## The Lister Institute of Preventive Medicine

THE report for 1943 of the Lister Institute of Preventive Medicine marks the fiftieth anniversary of the beginning of its scientific work and records work of a quality which reflects great credit on Sir John Ledingham, who has recently retired from the directorship, and on all his staff. The war-time dispersal of some of the staff to other laboratories may have its disadvantages, but it must have brought advantages also through the closer contacts made with other workers. For thirty-eight years Sir John Ledingham has been a member of the staff of the "Lister", and thirteen years ago he succeeded Sir Charles Martin as director. These are two names respected by every man of science; they both call up the vision of indefatigable work devoted to the betterment of the lot of mankind, the vision of men who have never sought publicity, of strong personalities whose modesty has always been an inspiration to all who came into contact with them. It is good to know that both are still at work. Every scientific worker will wish to take this opportunity to add to their public honours his tribute to their generous comradeship with the younger generation, their continual output of ideas, assistance and more and yet more results of their own outstanding labours.

## Diet of Wood Pigeons

THE recently issued sixth bulletin on wood pigeon studies being organized from the British Trust for Ornithology at Oxford contains some interesting observations of agricultural importance. The examination of nearly 4,000 wood pigeon crops suggests that, contrary to the general belief of farmers, wood pigeons do not eat the 'heart' or buds of clover plants; they eat the leaves and not the buds. Nor do they normally eat young corn but only the seed. During the mild winter of January and February 1943, wild fruits like ivy berries, haws and acorns were found in the 393 crops examined, whereas during the more normal winter of January and February 1942 (131 crops examined) the main food was shown to be cultivated clover. With the co-operation of phenologists a record is being made of the local variations in the abundance of acorn crops, because this seems to be the controlling factor for the movements of the wood pigeon flocks in Great Britain in winter. This might influence forestry work. The food habits of the smaller stock dove are shown to differ. This bird does not take the same food as the wood pigeon: it appears to be more of a ground-feeding species, living almost entirely upon cereals, weed seeds and roots. When the extra acres of woodland are scientifically managed after the War, they may attract the wood pigeon to feed there in the autumn instead of in the farm fields.

## Poisonous and Harmful Fishes of Australia

G. P. WHITLEY has produced a most useful guide to all the poisonous and harmful fishes likely to be encountered in Australia, New Guinea and the islands of the south-west Pacific (Bulletin No. 159, Council for Scientific and Industrial Research. Commonwealth of Australia. Division of Fisheries, Report No. 10, 1943). This work will be useful to members of the Allied Forces who may be unfamiliar with the fishes of these regions, many of which, although attractive in appearance, are very poisonous if eaten, while others possess spines in connexion with poison glands which, if encountered, may cause great pain. The report is well illustrated by coloured and uncoloured figures, and the descriptions are written in non-technical language. Simple methods of treatment for food poisoning and for wounds from venomous fishes are included, and there are also hints for collectors who may wish to preserve specimens. A more detailed and technical work with full bibliography on the same subject is to be publishedshortly.

## Mediterranean Culture

IN his Fraser Lecture under this title (Cambridge: At the University Press. Pp. 52. 2s. net) Sir John Myres deals with a culture which developed in "an exceptional human habitat". He analyses first the permanent features of the mode of life of the ordinary dwellers in this Mediterranean area. Here is a peasantry closely adapting itself to the possibilities which the environment offered, and a wider community drawing from outside, since "in a region so physically uniform it was necessary to go far for anything unusual". Hence the significance of the sea, and with it sea-power shown legitimately in commerce, colonization, and pilgrimage, and otherwise in piracy. Hence, too, the gulf between the city, product of this sea-life, and the peasantry, a gulf that "has become an enduring fact of Mediterranean life"; and on all, immigrants have made their influence felt. Sometimes they have been "transformed by transit through the mountain zone", sometimes they have disorganized life for a time, but only for a time, since "the primary economic groups persist or re-appear". This summary analysis, to quote the author, "if not quite historical geography is offered as an essay in geographical history". Many will derive pleasure and profit from what is thus offered.

## Inter-Allied Charter of Health

THE Anglo-Czechoslovak Founders Committee is offering a series of prizes for the best essays on an Inter-Allied Charter of Health. The subjects for consideration in the essays are: (1) the study and survey of post-war relief schemes and other measures for health planning; and (2) the draft of a project to implement Article 6 of the Atlantic Charter with reference to health. A competitor may deal with these subjects separately or jointly. The competition is open to all medical men, public health experts, biologists and other workers in services connected with health. The minimum prize will be £30, the maximum to be determined later. The final date of entry is December 31. The Council for Education in World Citizenship, in collaboration with the Anglo-Czechoslovak Founders' Committee, proposes instituting a parallel competition in British and Allied schools in Great Britain. Further information can be obtained from the Health Charter Study Group, c/o Czechoslovak Institute, 18 Grosvenor Place, S.W.1.

## Royal Society of Edinburgh: New Officers

AT the annual meeting of the Royal Society of Edinburgh held on October 25, the following officers were elected: *President*, Prof. E. T. Whittaker; *Vice-Presidents*, Dr. James Watt, Prof. T. H. Milroy, Sir John Boyd Orr, Dr. A. W. Greenwood, Prof. E. Hindle, Dr. D. Russell; *General Secretary*, Prof. James P. Kendall; *Secretaries to Ordinary Meetings*, Prof. R. J. D. Graham, Prof. W. M. H. Greaves; *Treasurer*, Sir Ernest Maclagan Wedderburn; *Curator of Library and Museum*, Dr. John E. Mackenzie; *Councillors*, Dr. Robert Campbell, The Right Hon. Lord Cooper, Prof. E. W. H. Cruickshank, Sir J. Donald Pollock, Mr. Stanley Cursiter, Dr. Douglas Guthrie, Prof. J. W. Heslop Harrison, Mr. Andrew W. Young, Prof. E. T. Copson, Lieut.-Col. W. F. Harvey, Prof. A. E. Trueman, Prof. John Walton.

## Announcements

THE following doctorates of the University of London have been conferred: *D.Sc.*: Mr. B. Katz, of University College; Mr. H. G. Wells, an external student; *D.Sc.(Eng.)*: Mr. G. Hughes, an external student; Prof. A. F. C. Pollard, University professor of (mechanical) instrument design, Imperial College of Science and Technology; *D.Sc.(Econ.)*: Mr. R. G. D. Allen, University reader in statistics, London School of Economics.

A DISCUSSION on "The Tetrapyrrolic Pigments" will be held by the Biochemical Society on November 13, beginning at 11 a.m. The meeting will be held in the Department of Organic Chemistry, Imperial College of Science and Technology, London, S.W.7. Further particulars can be obtained from Dr. W. Robson, King's College, Strand, London, W.C.2.

THE *Pharmaceutical Journal* has issued a pamphlet entitled "A Glossary of Terms used in Sex Hormone Therapy". The introduction explains that most of the human hormones, excepting adrenalin, are either proteins, protein derivatives or steroids, and a brief description of the nomenclature of the steroids is given. The Glossary will be useful to those who cannot make a special study of this field of work and who have little time to find a way through the maze of names in hormone literature.

MANUFACTURERS of insulin, in consultation with the Diabetic Association, have decided to standardize the colour and style of the packings, so that in future type and strength will be uniform irrespective of maker. Steps have also been taken to eliminate unnecessary deterioration in pancreas during transit from cold storage to manufacturing plant. The number of diabetics in Great Britain shows a yearly increase, and is now estimated at 200,000, but they do not all take insulin. The Ministry of Supply states that adequate supplies of insulin have been ensured both for the home market and for liberated countries.

A MILLION dollars has been set aside by the Council for the Promotion of Science and Technology in China as cash awards for solutions of national defence scientific problems. The Council for the Promotion of Science and Technology has selected ten special industrial and scientific problems for consideration. Chinese men of science, industrial technicians and research workers are invited to engage in studies and research on these problems and submit reports of their results to the Council before the end of the current year.

# LETTERS TO THE EDITORS

*The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.*

## Localization of Chemoreceptivity in Drosophila

THE outbreak of war brought to a standstill a programme of experimental investigations into the genetics of behaviour patterns among Drosophila mutants in the laboratory of the senior author of this note. The end in view was threefold: (*a*) to take advantage of structural modifications of putative receptor organs by mutation as a basis for exploring their functions; (*b*) to gain knowledge of reproductive behaviour requisite to further investigation of assortative mating; (*c*) to standardize the genetic variables affecting behaviour patterns as a basis for inquiries of either type. Recently it has been possible to make a fresh start. The object of this preliminary note is to indicate some positive conclusions about the localization of chemoreceptivity by study of the reactions of mutants with antenna defects or abnormalities, more especially *antennaless*, discovered by Gordon and Sang[1], and *aristapedia*.

The characteristic of the latter is replacement of a normal antenna by a leg-like appendage which, however, bears peg-like organs and other structures of supposedly receptive function present in normal antennæ but not in the normal leg. Full exhibition of the gene *antennaless* leads to complete suppression of both antennæ, partial exhibition to unilateral suppression. By varying the conditions of culture, Gordon and Sang[1] showed how it is possible to obtain genotypically homozygous antennaless individuals with no manifest somatic effect of the gene. Among flies of pure stocks we may therefore distinguish between what they respectively call *antennaless* ($A_0$) phenotypes, half antennaless ($A_1$) with unilateral exhibition and wild type antennaless ($A_2$), the latter being genotypically equivalent to the first two but phenotypically like ordinary flies. It is therefore possible to use as controls flies without antennæ genotypically identical with flies which have them on one side or both sides. Our experiments with these stocks include tests on their phototactic and geotactic reactions, their behaviour in a humidity gradient and their response to solutions containing volatile constituents. This note deals only with results of the last-named class.

As is well known, yeast culture and solutions containing ethyl alcohol acetic acid and various esters exert attraction for *Drosophila melanogaster*. A mixture ('*M*') containing baker's yeast, ethyl alcohol and traces of acetaldehyde, ethyl acetate, methyl acetate and butyric acid attract the flies more strongly than any single constituent. For that reason we have used it for trapping experiments essentially like those of Barrows[2]. The method was to release large numbers of flies in a chamber with traps containing *M* or water ('*W*') as a control. Results of a typical experiment with antennaless stocks are in Table 1, showing the number of flies trapped as a percentage of the number of a given category released. $O_r$ stands for wild type flies of Oregon stock.

Experiments with various mutants having structural defects of the wings leading to defective power of flight conclusively exclude the possibilities that the negative chemoreactivity of the antennaless ($A_0$) flies is not due to mechanical inability to reach the goal. From this point of view, experiments (Table 2) involving flies ($A-V_g$) homozygous for both the vestigial gene and for antennaless are sufficiently explicit.

TABLE 1.

| Solution | Percentage of flies of each class trapped | | | | Total of each group released |
|---|---|---|---|---|---|
| | $A_0$ | $A_1$ | $A_2$ | $O_r$ | |
| *M* | 1 | 31·5 | 52·5 | 58·7 | 400 |
| *W* | 3 | 8 | 5 | 6·7 | |

TABLE 2.

| | $A_0-V_g$ | $A_1-V_g$ | $A_2-V_g$ | |
|---|---|---|---|---|
| *M* | 4·5 | 46·4 | 98·2 | 112 |
| *W* | 0·0 | 1·0 | 0·0 | |

TABLE 3.

| | $SS^a$ | $Y-V-F$ | $F_1$ | |
|---|---|---|---|---|
| *M* | 43·6 | 61·9 | 70·0 | 360 |
| *W* | 3·3 | 3·6 | 1·9 | |

A comparison between the behaviour (Table 3) of mutants, for example, *yellow-vermilion-fork* and *filamentless* ($F_1$) with normal antennæ and *aristapedia* ($SS^a$) shows that the macroscopic modification of the antennæ in flies of the last-named type does not eliminate chemoreceptivity, though diminishing it somewhat. The characteristic of the *filamentless* mutant control is absence of filaments ordinarily attached to the egg-case.

We have tested the main conclusions illustrated by such experiments with a new type of olfactometer to be described in a forthcoming publication. This device eliminates air flow, offering flies the choice between an exit leading to a chamber containing the attractive mixture and a control chamber with water. The results substantially confirm those of trapping released flies; but also show that total absence of antennæ does not *entirely* abolish receptivity to vapours.

Since microscopic examination of the leg-like antenna of *aristapedia* reveals the presence of the type of sensilla in the distal joint of the normal antenna, our results point to the conclusion that these organs are the chief olfactory receptors involved in the search for food. However, the peg-like organs of *aristapedia* are not the only morphological differentiæ which they share with a normal antenna in contradistinction to a normal leg; and we are at present investigating the possibility of a more precise identification of the relevant structures by recourse to study of other mutants. Meantime, we have clear-cut evidence that olfactory receptivity of Drosophila, at least with respect to its as yet known chemoreactions, is located almost exclusively in the antennæ.

We acknowledge with appreciation financial assistance from the Rockefeller Foundation for renewal of work on these problems.

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LANCELOT HOGBEN.

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Oct. 6.

[1] Gordon, C., and Sang, J. S., *Proc. Roy. Soc.*, B, **130**, 151 (1941).
[2] Barrows, W. M., *J. Exp. Zool.*, **4**, 515 (1907).

## Trypan Blue and Cell Migration in the Adrenal Cortex of Rats

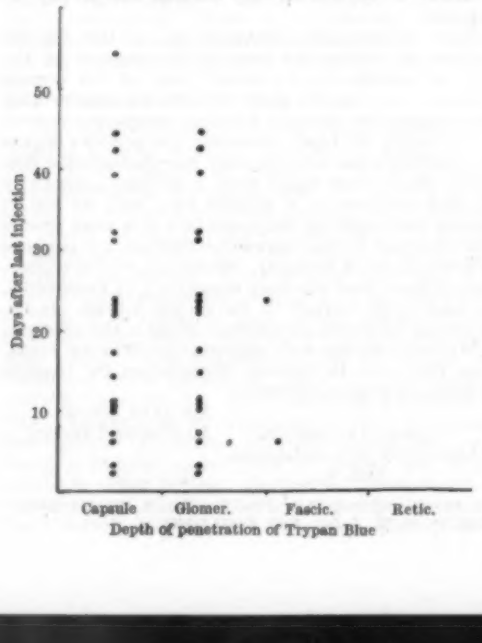
THE hypothesis has recently been put forward that there is an inward cell migration in the adrenal cortex. According to Zwemer *et al.*[1,2], in several species capsular cells multiply and move inwards, becoming in turn cells of the glomerular, fascicular and reticular layers. In guinea pigs Blumenthal[3] found that there is a zone of mitotic activity comprising the inner glomerular and outer fascicular layers, and Hoerr[4] found after chloroform narcosis increased mitotic activity in the outer fascicular layer.

Recently, Salmon and Zwemer[5] claimed that in rats Trypan Blue injected subcutaneously was first taken up by fibroblast-like cells in the capsule, and that afterwards dry droplets were to be found at varying intervals of time in the glomerular, fascicular and reticular zones successively, while the outer layers ultimately became free from the dye. On the basis of these findings they concluded that there was a progressive inward cell migration.

In the hope that this method might provide a reliable technique for the standardization of substances acting upon the cortex, we carried out similar experiments on seven batches, each of six male rats, some of the batches being composed of immature animals. The Trypan Blue was injected in doses of 1–3 c.c. of a 1 per cent solution in saline. The rats were killed 2–54 days after the last injection. Both glands were removed, and stained and unstained sections were examined.

In all sections examined, Trypan Blue droplets were present in the capsule, independent of the lapse of time after injection and the dosage given. Trypan Blue was also found frequently in the glomerular zone and very occasionally in the outer fascicular layer; but the depth of penetration of the dye bore no relation whatever, either to the time interval after the last injection, or to the dose given. The results obtained are plotted on the accompanying chart.

This method thus yields no evidence for centripetal cell migration in the adrenal cortex. The Trypan Blue uptake of the cells of the deeper fascicular and the reticular layers observed by Salmon and Zwemer may perhaps be due to the massive doses used (21–30 c.c. of a 1 per cent solution), which resulted in a generalized absorption of the dye by the whole cortex. It seems possible that the uptake of Trypan Blue and its subsequent appearance in droplet form in the fibroblast-like and glomerular cells is due to the macrophagic activity of the former and to some metabolic peculiarity of the latter, not normally possessed by the cells of the fascicular and reticular zones.




We would like to thank Prof. Samson Wright and Dr. J. H. Woodger for their interest and criticism.

ITALO CALMA.
CHARLES L. FOSTER.

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London, W.1. Oct. 5.

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## Amount of Heterochromatin as a Specific Character

ONE general fact which emerges from recent work in animal cytology is that the extent of the heterochromatic ('inert') segments of the chromosomes often varies very greatly from one species to another, even within the same genus. Thus, among the grasshoppers, *Stauroderus scalaris* possesses very large proximal heterochromatic regions in all the chromosomes, while in other species of the genus these regions are very much shorter and less conspicuous[1]. The same difference has long been known to exist between species of Drosophila, where *D. virilis* has the proximal half of each autosome heterochromatic, while in some other species such as *busckii* there is far less heterochromatin. These species belong to different subgenera; but it has recently been shown by Wharton[2] that *D. melanopalpa* has considerably more heterochromatin than the very closely related *repleta*. In the Pentatomids, Schrader[3] has shown that *Edessa irrorata* has prominent heterochromatic blocks at the ends of most or all of its chromosomes, which are not obvious in several other members of the same genus. An identical situation occurs in the Corixidæ, where Slack[4] has shown that *Corixa punctata* is a species with unusually extensive heterochromatin.

Since this phenomenon is clearly one of very widespread occurrence in animals (and possibly in plants as well) it seems desirable to have words to designate species with more or less than the average amount of heterochromatin for the group to which they belong. I should like to suggest that species like *Stauroderus scalaris*, *Edessa irrorata*, *Drosophila virilis* and *D. melanopalpa* be called 'megaheterochromatic', the species with little heterochromatin being referred to as 'microheterochromatic'. It is unfortunately not always easy to distinguish between species in which the heterochromatic regions are long and those in which they are of average length but unusually strongly heteropycnotic at certain stages of the nuclear cycle. It is believed, however, that all the examples cited do actually represent cases where the heterochromatic segments are unusually long, although they may also be more strongly heteropycnotic than usual.

Heterochromatin, in all those forms where its

functions have been analysed genetically, seems to be relatively, but not entirely, inert. That is to say, a heterochromatic region of a chromosome has fewer genes per unit length (as measured at mitosis) and these genes seem to be mostly ones the phenotypic effects of which are individually slight. Duplications or deficiencies of heterochromatic regions are likely to affect the viability of the organism much less than duplications or deficiencies of comparable length in the euchromatic segments. Thus the amount of heterochromatin may be expected to vary more from species to species than the length of the euchromatic segments. But this variation is clearly not haphazard and without significance, since in the megaheterochromatic species the increase of the heterochromatic regions usually seems to have taken place in a very regular and orderly manner in all the chromosomes. Heterochromatin seems to be an invariable constituent of every chromosome, that is to say, all chromosomes contain one or more heterochromatic segments, which may be long or short.

We unfortunately know very little as yet about the role of heterochromatin in the physiology of the cell; but it is certainly bound up in an intimate way with the whole nucleic acid and protein-synthesis cycle. It is thus quite likely that general differences of a physiological nature may exist between megaheterochromatic and microheterochromatic species. The latter have seldom been studied in detail by cytologists, since it is the presence of conspicuous heterochromatic blocks (rather than their absence) which has attracted attention. Most of the authors cited above who have studied megaheterochromatic species were primarily interested in the phenomenon of non-homologous 'pairing' between the heterochromatic segments, that is, the fact that the ends of the chromosomes are stuck together at certain stages of mitosis and meiosis to form 'chromocentral' associations. This seems, however, to be merely incidental to the megaheterochromatic state.

It may be worth pointing out that a comparison between resting somatic nuclei from the same kind of tissue in a number of related species is usually quite sufficient to determine the amount of heterochromatin in a rough manner: in the megaheterochromatic species the chromocentral masses will be very much larger. Eventually, perhaps, we shall have some kind of quantitative index to express the amount of heterochromatin in a species; at the moment all that seems necessary is a pair of terms to describe the extreme members of what is really a long series. Where heterochromatic supernumerary chromosomes are present in varying numbers in a species (as in the case of the B-chromosomes of maize and the supernumerary X's of the bed bug[4,5]), this series exists within the species, so that we can distinguish between megaheterochromatic and microheterochromatic individuals. This is clearly an unusual situation, but an investigation designed to detect slight physiological differences between these individuals might throw considerable light on the more general problem of interspecific differences in the amount of heterochromatin present.

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London, N.W.6. Oct. 2.

[1] Corey, *J. Morph.*, **55**, 813 (1933).
[2] Wharton, Univ. Texas Publ. No. 4313, 282 (1943).
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## Aqueous Soap Solutions of Carcinogenic Hydrocarbons

THE fact that carcinogenic hydrocarbons are insoluble in water has limited the means of administering them experimentally to the use of oily solutions or colloidal suspensions. In feeding experiments, it is a practical advantage to be able to administer substances dissolved in drinking water. Lorenz and Stewart[1] have used hydrocarbons dissolved in stable oil-in-water emulsions. Their method was adopted in some experiments in this laboratory. Where it is desired to achieve rapid absorption of a carcinogenic hydrocarbon from a mucous membrane or from the site of parenteral injection, an aqueous solution has obvious advantages.

Use was made of the mutual miscibility of ether soap and water to prepare aqueous soap solutions of several carcinogenic hydrocarbons. The following method was found to give good results: Up to 120 mgm. of 20-methylcholanthrene or 3:4-benzpyrene are dissolved in 10 c.c. of ether, and this solution is added to 50 c.c. of ethereal soap solution. This is the stock solution. Immediately before use, the stock solution is slowly mixed with as much water as is necessary to obtain the desired percentage of hydrocarbon and of soap. The ether is driven off by heating to boiling point. 1 c.c. of the ethereal soap solution used contains 1·8 gm. soap. To obtain a 0·01 per cent solution of hydrocarbon, 6 c.c. of stock solution is mixed with 120 c.c. of water, the percentage of soap being 7·5 per cent by weight. This strength has been used in practice. Fluorescence spectroscopy reveals identical bands for 3:4-benzpyrene in aqueous soap solution and in acetone.

After dilution with water, the hydrocarbon solution is at first quite clear, but opalescence gradually develops in the course of a few hours. Even so, the particles are much smaller than those of colloidal suspensions.

Rats show no aversion to drinking 0·01 per cent hydrocarbons in 7·5 per cent aqueous soap solution, and have showed no toxic effects after drinking it daily for six weeks.

After intravenous injection of such aqueous soap solution of 3:4-benzpyrene into mice, biliary excretion occurred in the same way as after similar injections of colloidal suspensions[2].

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Sept. 29.

[1] Lorenz, E., and Stewart, H. L., *J. Nat. Cancer Inst.*, **1**, 17 (1940).
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## Regulated Degradation of 1,3 Polysaccharides

IT has been shown[1] that when 1,4 polysaccharides, such as starch or cellulose, are treated with periodic acid solution, the carbon chain in each sugar unit is ruptured between carbon atoms 2 and 3, the —CHOH groups at these positions being oxidized to —CHO. Acid hydrolysis of these oxidized polysaccharides yields solutions containing glyoxal and erythrose. It has now been shown in this laboratory that aqueous solutions of periodic acid-oxidized starch or cellulose yield, when treated with phenylhydrazine acetate, a yellow amorphous precipitate. When the mixture is heated on the water-bath,

glyoxalosazone is rapidly formed in crystalline condition. The glycosidic linkage, which is fairly resistant to acid hydrolysis, is thus readily opened by the phenylhydrazine reagent under mild conditions.

The interest of this reaction lies in the fact that it may be used to bring about a regulated degradation of 1,3 polysaccharides such as laminarin and the glucan of yeast membrane. It has been shown[2,3] that periodic acid oxidation of these polysaccharides affects only the non-reducing terminal sugar unit, by eliminating carbon atom 3 and oxidizing the —CHOH groups at positions 2 and 4 to —CHO. Treatment of the oxidized polysaccharide with phenylhydrazine acetate brings about a rapid separation of glyoxalosazone, and the polysaccharide, the chain-length of which is now shorter by one glucose unit, may be readily recovered. The new terminal non-reducing unit may again be oxidized by periodic acid, and glyoxalosazone again eliminated on treatment with the phenylhydrazine reagent. In this way, the sugar units may be eliminated one by one from the non-reducing end of the polysaccharide chain.

The course of this degradative mechanism may be checked at intervals by oxidizing the —CHO groups in the terminal unit to —COOH. The dicarboxylated end-group may then be assayed by neutralization (Barry[3]). The application of this method to yeast glucan, laminarin and other algal polysaccharides of the 1,3 type is at present being investigated in this laboratory. So far the degradation seems to be proceeding as outlined above, although in the case of the yeast glucan, there is evidence that it is halted after ten successive removals of glyoxalosazone. If this should be confirmed by repeated experiments, the failure to degrade the molecule further could be explained on the basis that one or more side-chains had been eliminated, leaving a closed loop of glucose units which now presents no point of attack to the periodic acid.

The reaction should also prove of value in detecting linkages other than those of the 1,3 variety in polysaccharides where the 1,3 linkage predominates. Where, for example, a 1,4 linkage is present, oxidation and subsequent treatment with the phenylhydrazine reagent should bring about a fragmentation of the polysaccharide chain with the production of oligosaccharides of shorter chain-length.

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[1] Jackson and Hudson, *J. Amer. Chem. Soc.*, **59**, 2049 (1937); **60**, 989 (1938).
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## Mid-dorsal Hair Whorls in Papuan Children

THE occurrence of hair whorls in the mid-dorsal region of man has been recorded in a high percentage of Australian aborigines[1,2], in a few Hawaiian fœtuses of mixed ancestry[3] and in one European[4]. Osman-Hill has observed the same anomaly in Veddahs[5].

During a spleen survey of native children in the village of Buna, in northern Papua, the dorsal hair whorl was observed in six out of eighteen children examined. In all cases the whorl was anti-clockwise in direction and centred over vertebral spines *D*4, *D*5, *D*7, *D*10 (each once) and *D*6 (twice).

The significance of this type of hair tract arrangement is obscure; its occurrence in this group of Papuan villagers extends its known range.

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June 1.

[1] Wood-Jones, F., *J. Anat.*, 91 (1934).
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## Afterglow in High-Pressure Gaseous Discharges

THE persistence of luminosity after the interruption of an electrical discharge in certain gases at low pressures has often been observed, and the experiments on active nitrogen by Lord Rayleigh, and others[1,2], are well known. Dorgelo and Washington[3] have measured the persistence of metastable states in helium, neon and argon; Kenty[4], and Mohler[5], have studied the effect of electronic recombination in the afterglow.

The present experiments differ from those mentioned above in that newer methods of observation and high-pressure spark discharges are used. The results are of some practical interest in the field of high-speed photography.

Recurrent condensed spark discharges were used and the current/time relation for the discharges was accurately determined by means of a cathode-ray oscillograph. In all cases where the afterglow was more than about 5 microsec., the discharge current fell to a negligible value before the glow was extinguished. While it was difficult to prevent a very small current from flowing during the afterglow, such a current is clearly not the sole factor controlling the afterglows, which vary widely from gas to gas. The current/time relation is little affected by a change of gas for the same circuit conditions.

Figs. 1 and 2 are photographs taken with a rotating mirror camera; the time-scale is given with the figures. The hydrogen sparks, three of which are shown in Fig. 1, show no appreciable afterglow compared with argon (Fig. 2), although the spark channel, as would be expected, is wider and more sharply defined in hydrogen than in other gases. The rotating-mirror photographs for hydrogen could not be distinguished from stationary mirror photographs of similar sparks. Owing to the intense afterglow, and lack of boundary definition, the spark channel cannot be clearly distinguished in the argon discharge of Fig. 2.

The argon afterglow varies widely for different sparks in given circuit conditions. The records show that the afterglow is either uniform and wedge-shaped on the photographs, showing a greater persistence of illumination in the centre of the gap, or is composed of a number of more or less separate luminous regions, of which at least four are shown in Fig. 2. It would appear, therefore, that the amount of light in the afterglow varies considerably from spark to spark, especially in the later stages of the discharge. A similar effect is obtained for long sparks in air, as shown in the rotating-film camera records of Allibone and Meek[2], where again the persistence of exceptionally long afterglows at certain points in the discharge is apparent.

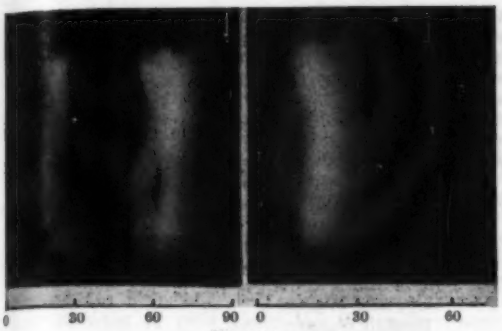


Fig. 1.




Fig. 2.

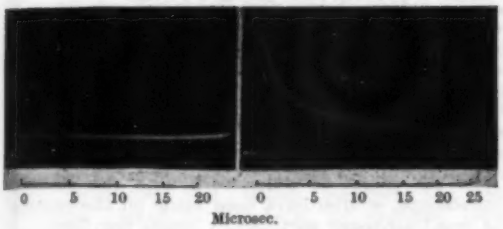


Fig. 3.




Fig. 4.

DISCHARGES ACROSS POINT/POINT GAPS (TUNGSTEN ELECTRODES 1/16 IN. DIAMETER, WITH HEMISPHERICAL ENDS) IN 99·5 PER CENT HYDROGEN (0·5 PER CENT OXYGEN), FIGS. 1 AND 3: AND IN 98 PER CENT ARGON (2 PER CENT NITROGEN), FIGS. 2 AND 4.

| Fig. | Pressure (atmospheres) | Gap length (cm.) | Capacitance (mfd.) | Approx. circuit resistance (ohms) | Condenser voltage (kV.) |
|---|---|---|---|---|---|
| 1 | 1·5 | 1·0 | 0·04 | 13 | 12·5 |
| 2 | 1·5 | 1·0 | 0·04 | 13 | 9 |
| 3 | 1·0 | 0·5 | 0·02 | 39 | 14·6 |
| 4 | 1·0 | 0·5 | 0·02 | 39 | 14·6 |

An electron multiplier was used to convert the light pulses from the spark into electrical pulses. Recurrent spark discharges were used, with the spark and the oscillograph time sweep triggered synchronously. The variable nature of the afterglow in argon is borne out in the oscillogram of Fig. 4, which shows the light output from some thousand sparks as a function of time. The intensity of light emitted in the early stages of the discharge is roughly the same for each spark, but there is considerable variation during the later stages. Fig. 3 is a comparable record of the light emitted by many sparks in hydrogen. In this case there is no observable difference in the light/time relation for the separate sparks. The results obtained with the electron multiplier therefore confirm the rotating-mirror records. The effect should be considerably enhanced by the use of a slit, arranged perpendicular to the spark channel. The amount of light passing through the slit to the electron-multiplier would probably then vary much more than the total amount of light for different sparks. It is, of course, the latter quantity that is measured in the experiments discussed above (Fig. 4).

After the electron-multiplier arrangement was devised, similar results with low pressure glow discharges in nitrogen were published[6] and brief references to the study of luminescence in solids, also using an electron-multiplier, have been found[7,8].

As both the electron-multiplier and the spark gap were enclosed in glass bulbs, little ultra-violet radiation from the sparks is recorded. However, the present results are intended only to show qualitatively the nature of the phenomena. In particular, it is important to check, more fully than has yet been possible, the response of the multiplier tube. Also it is hoped that, as circumstances permit, the work will be increased in accuracy and extended in scope to include measurements on the relative and absolute quantity of light emitted by spark discharges in various gases. The use of filters to study light of different wave-length ranges is also contemplated. It is hoped that detailed publications will appear in the future.

Another possible application of the technique, using an electron multiplier and an oscillograph, is the study of the development of the leader strokes which precede spark discharges. The time interval between the leader stroke and the main return stroke might be observed at different points in the gap with a higher degree of resolution than is possible with the rotating camera, where in some cases there is difficulty in distinguishing the leader stroke on account of the relative intensity of the main stroke if the camera speed is insufficiently high. Also, in rotating camera photographs the spatial width of the discharge can confuse the determination of the time relationship, and introduce appreciable inaccuracies even in cases where the camera speed is high enough to separate clearly the leader from the main stroke.

We wish to thank Dr. A. P. M. Fleming, director and manager of Research and Education Departments, Metropolitan-Vickers Electrical Co., Ltd., for permission to publish this note.

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## Rugosity of Granular Solids

Now that the specific surface of a powder or granular solid can be quickly measured by the air-permeability method of Lea and Nurse[1] or by Rigden's simplification of the method[2], it has become possible for the first time to measure the average roughness and angularity, or 'rugosity' as we may call it, of the individual grains.

Rugosity we define as the ratio of the measured specific surface to the hypothetical surface area which the grains would have if they were all spherical. Wadell[3] recognized the value of this ratio or rather of its reciprocal, sphericity, but was unable to avoid a time-consuming method of measuring the dimensions of many individual grains.

Calculation of rugosity by the present more rapid

method is based upon the determination of the specific surface and the particle size distribution. The first of these we measure by the air-permeability method of Lea and Nurse, the cell being modified for coarser particles into a longer and narrower tube; the second is measured by means of an accurately calibrated set of sieves, preferably in a mechanical sieving machine.

The coefficient of rugosity is expressed by the formula:

$$\frac{S_w}{\Sigma a_i . \pi . d_i^2}$$

where $S_w$ is the measured surface area of 1 gm. of material in c.g.s. units, $a_i$ is the number of particles having a diameter $d_i$ in the same mass (dimension $[M^{-1}]$), $\pi\, d_i^2$ is the surface of the hypothetical sphere made out of each particle, and the sum $\Sigma$ represents the total surface of 1 gm. of this idealized material. Using the value $w_i$, the proportion of the mass in the $i^{th}$ sieve fraction (dimensionless), we can write:

$$w_i = a_i \tfrac{1}{6} \pi\, d_i^3 \rho,$$

where $\rho$ is the density of the material. We can also calculate $a_i$, which is:

$$a_i = \frac{6\, w_i}{\pi\, d_i^3\, \rho};$$

and from this we arrive at the coefficient of rugosity:

$$\frac{S_w\, \rho}{6 \Sigma\, (w_i/d_i)}$$

which is dimensionless.

It should be noted that $a_i$, used in the intermediate calculation, does not represent the actual number of irregularly-shaped particles, but the number of spheres that can be made out of each fraction keeping the experimentally determinable $w_i$ and $d_i$ correct.

An improvement can be made in the accuracy of the results if, instead of the actual sieve analysis figures, closer values are read from a frequency curve, which can be prepared by the graphical differentiation of the cumulative curve. Sieve sizes should be chosen so that not too high a proportion of the whole sample finally rests between two sieves.

The new method was developed in the course of work on the properties of synthetic steel moulding sands. It was found that two sands having the same specific surface, when mixed in the same way with the same proportion of water and 'Fulbond', a bonding material produced from fullers' earth, behaved quite differently in the green compression strength and plasticity tests. Microscopical examination showed that the grains of one of the sands were larger, rougher and more angular than those of the other.

The coefficients of rugosity of these silica sands are usually between 1·05 and 1·40, approaching unity when the grains are well rounded. The method is being applied by the Department of Refractory Materials, University of Sheffield, in the study of silica sands for use in synthetic moulding and core sands being conducted in conjunction with the Moulding Materials Sub-committee of the Iron and Steel Institute's Steel Castings Research Committee, and has yielded information of considerable value.

Coefficients of rugosity are likely to be valuable in the study of the flow properties of dry powders, and of the rheological properties of insoluble powder – liquid systems. It is a useful measurement for evaluating substances which are required to have a high specific surface combined with a high permeability to fluids, such as fullers' earth and base exchange materials. The method can probably be used for estimating the degree of aggregation of particles the separate particle size of which can be otherwise determined. So far the measurement has not been extended to particles which are platy or acicular, but a correction for particle shape could probably be made in the sieve analysis as suggested by Rittenhouse[4].

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## Electron Microscope Studies of the Capture of Air-borne Particles by Single Fibres

IN the course of some work with the electron microscope, studies have been made on the capture of small air-borne particles by single fine fibres.

In the accompanying illustration, *a* is the electron microscope picture (× 1900) of a collection of fine sodium chloride crystals clinging to a fine rubber fibre. Sodium chloride solution had been sprayed with an atomizer into air which was drawn past the fine fibre. The dotted line in *b* indicates the size of the fibre, which was approximately 0·7 mμ in diameter.

*a* *b*

The negative from which this print was made was projected on a wall screen so as to give an image considerably larger than the accompanying figure, and the apparent boundaries of the individual crystals were sketched on the screen; *b* is a photograph[1] of the resulting drawing, and gives a very interesting picture of the way crystals are caught and packed together.

This work was carried out in the course of experiments done by Dr. Beatrice Deacon, Dr. L. T. Newman and Dr. J. H. L. Watson; this particular experiment was done by the last-named.

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# AN INTERNATIONAL INFORMATION COUNCIL*

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VALUABLE information on a subject is frequently scattered outside the recognized field of that subject and may appear in unexpected types of literature, as illustrated by the classical example of Mendel's two papers on his famous laws governing the inheritance of characters in plants and animals, which lay in obscurity for thirty years, and the remarkable French patent specification of Penaud and Gauchot of 1876 describing the modern aeroplane in detail, which was not brought to light before 1916.

Extensive search is necessary to gather all the available information on any subject, and the magnitude of the searching and sifting process is beyond the capacity of individual information services. Moreover, most services entirely neglect certain kinds of literature, such as university theses, patent specifications and trade literature, all of which are essential material for particular groups of people. Some services, however, recognize the importance of such literature. The Mellon Institute and the Carnegie library at Pittsburg, for example, have formed large collections of trade literature indexed by subject and name of firm.

The vast task of indexing the current literature alone could only be carried out by a carefully planned international organization by which the contents of all non-fiction literature were analysed, classified and recorded in the form of a simple bibliographical reference, as distinguished from a compound reference in which the simple reference is compounded with notes or an abstract. For the smooth working of the plan to be described, it is essential that these simple bibliographical references should be subject-classified by a standard international code, such as that known as the Universal Decimal Classification now in course of publication as a British Standard by the British Standards Institution, and prepared in a standard form which will shortly be published by the same body.

Bibliography is the work of specially qualified people. Usually the research worker, in whatever domain of learning he may work, is not qualified for bibliographical research, and in any event is denied the facilities open to the professional bibliographer. The intrusion of such work into his otherwise occupied time is resented, and in consequence his references are fragmentary and exert an undesirable influence upon the quality of his output. It was necessary to organize groups of specially qualified persons to analyse and classify man's priceless inheritance of recorded knowledge in order to make full use of it for the benefit of mankind.

In the international organization proposed, a supreme body, the International Information Council, is linked to national information committees situated in the literature-producing countries of the world, and under each national committee a family of national information bureaux carry out the work of recording the contents of the national literature. The essential feature of the plan is that the national information organization of a country shall deal exclusively with the literature produced in that country.

The organization is intended to serve government departments as well as the public, and the bodies composing it should be governmental or semi-governmental bodies subsidized by government funds. The bureaux under the national information committee of a country would deal with specific domains of the national literature, such as those concerned with general works, science and technology, agriculture, medicine, fine arts, philosophy, theology, sociology and law, commerce, languages, literature, history, etc.

The organization, in fact, is somewhat similar to the system of the Executive Council of the Imperial Agricultural Bureaux, with its twelve sections each concerned with a branch of science bearing on agriculture, which according to the report of the British Commonwealth Science Committee of March 29, 1943, ". . . has since its inception in 1929 been an outstanding success in providing a vital service, collecting, collating, and disseminating information on agricultural research to workers throughout the Empire and the world. The fact that this organization, administered by a constitutional and representative executive council sitting in London, has been continuously supported since 1929 by the whole Empire on the basis of an agreed contribution, surely implies that governments would be sympathetic towards an extension of such a scheme to other essential scientific services".

The personnel of the International Information Council should include representatives of the national information committees, and the personnel of each national information committee should include representatives of its bureaux, which consist of information officers fully qualified to deal with the literature of their respective subjects.

Assuming that the standard methods of preparing simple bibliographical references and the standard classification have been internationally adopted and that the world organization is in operation, current literature would be dealt with in the following manner. A list of the national material, as and when published, is obtained by the national information committee from the national library enjoying the rights of legal tax, or failing that from publishers' catalogues and other sources. The documents are obtained and roughly classed by the standard classification numbers and distributed to the bureaux. If the bureaux are assigned the classification numbers of their subjects, the distribution by means of these 'bureau numbers' becomes automatic. But some of the documents received by a bureau may contain 'unwanted' matter; in this case it is roughly classed and sent to the correct bureau for action. The bureaux prepare the MSS. of the references, which are printed on the international standard card, by the national committee. Copies of the cards are then distributed by the bureaux to their opposite numbers in other countries by means of air transport, in order to reduce the time of distribution to a minimum. It will be noted that in this process of distribution, it is not necessary for analogous bureaux in the different countries to have precisely the same bureau numbers, since it is only the bureau numbers which are the instruments of selection.

In this way each bureau will accumulate those references to the current literature of the world concerning its specific domain of information, and will

* Substance of a paper on "A Plan for Mobilizing Bibliographical References to the Contents of the World's Non-Fiction Literature" read at a meeting of the British Society for International Bibliography on September 29.

build up a classified subject, or more correctly an 'ideological' card repertory of simple bibliographical references, which can be filed in duplicate to form an author, title, or generally an 'onomastic' card repertory.

Non-current literature could be gradually dealt with in the same way by systematic reference to accession lists and union catalogues. The records for the non-current literature of a country would take many years to complete, but it is important that the current literature should be attacked as soon as possible before the growing mass gets beyond human control.

By an extension of the exchanging process to the national committees, a great central repertory of all information could be formed, but the enormous mass of references which would accumulate and the space required for storage would make such a proposition impossible to entertain, even if any advantages could be gained by having such a colossal and central national repertory. Each bureau must necessarily be established at an information centre where the material and the card repertories may be stored for use by the information officers and the public.

The application of this proposed organization to British bibliography might be made in either of two ways. The countries of the Empire may be regarded either in the geographical sense, each with its own national committee and family of bureaux, or the whole British Commonwealth may be grouped under one national committee, which might be called the British Commonwealth Information Committee. With this arrangement the bureaux probably would function as successfully as the twelve branches under the Executive Council of the Imperial Agricultural Bureaux.

Suitable British information centres should be government and public institutions in London, such as the libraries of the Science Museum—for the bureau or bureaux dealing with science and technology—the Victoria and Albert Museum, the Public Record Office and so on. Other libraries and institutions in different parts of the country should be authorized to obtain copies of any desired domains of the official card repertories, so that the records could be dispersed over the country for the benefit of the nation.

The organization is thus fundamentally concerned with the analysis and classification of information in the form of simple bibliographical references. Other services such as abstracts, progress reports, the provision of photo-copy, translation, special bibliographies on demand, loan services, etc., should be regarded as services outside the activities of the official international organization. Many of these services are in vigorous activity and obviously should be improved and developed by the use of the complete records filed in the card repertories of the official organization. It is stated in the report of the British Commonwealth Science Committee, to which reference was made above, that "The case for collaboration in the production of scientific abstracts of high quality for the common use of the English-speaking world is very obvious, and would have the strong support of the Committee". If the major abstracting services would agree to collaborate and adopt a method of passing on 'unwanted' matter to the appropriate service, in a manner similar to that described for material 'unwanted' by the official bureaux, the case might be made. The official card repertories unquestionably would greatly assist the abstracting services and help to avoid duplication, more especially if each abstracting service was identified by classification numbers.

This immense international organization with its bureaux all over the world could not, of course, be established in its entirety in the first instance, but there appears to be no reason why the plan should not be initiated by the establishment of an Anglo-Soviet-American organization, primarily concerned with British, Russian and American current literature. The literature of other countries could be divided by agreement among the three members of the United Nations, and the work undertaken for any country in this way could be handed over as soon as its national information committee with the necessary bureaux had been established by the assistance of the International Information Council.

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## X-RAY ANALYSIS GROUP OF THE INSTITUTE OF PHYSICS

FOR some time past the need has been felt for closer co-operation between the users of X-ray diffraction methods. In industry, for example, many new applications are being found for these methods, and their simplicity and directness make them valuable additions to industrial testing procedure. Their use may sometimes be entirely empirical, but a sound understanding of the theoretical basis is necessary in order that the practical worker shall both recognize the limitations of his methods and be able to tackle the more unusual problems that are bound occasionally to be presented to him. It is desirable, therefore, that there should be some means for the technician to become acquainted with the latest results of theory, and for academic circles to learn of the problems that X-ray analysis is being called upon to solve.

The need has been partly met by the X-ray Conferences of the Institute of Physics, which were held in Cambridge in 1942 and 1943. Though their support, both from industry and from the universities, was evidence of their success, the Board of the Institute has realized that such conferences can be of only limited value, and has now authorized the formation of an X-ray Analysis Group.

Despite its connexion with the Institute of Physics, it is not intended that the membership should be confined to physicists. Since the formation of the Group has been sponsored by the Institute, the present committee has a strong bias on the side of physics, but it is hoped that it will become more truly representative of the different branches of science as vacancies in it are filled by election.

The inaugural meeting of the Group was held on Saturday, October 16, in the Physics Department of the University of Manchester, at the invitation of the Manchester and District Branch of the Institute. Dr. F. C. Toy was in the chair. The papers read illustrated very well the objects for which the Group was formed.

The main lecture was given by the chairman of the Group, Sir Lawrence Bragg, on "The Physical Optics of X-Ray Analysis". Sir Lawrence emphasized the essential similarity between the diffraction of light by a grating and of X-rays by a crystal, and showed how the same principles can be applied to both. He spoke rather regretfully of the tardiness

with which the mathematical theory of diffraction has been applied to X-ray problems and said that, now that the theory has been worked out, it is essential that those who use X-ray diffraction methods should make themselves acquainted with it; the 'Bragg Law' does not contain the whole of the subject.

Sir Lawrence then described the fundamentals of the theory of X-ray diffraction and the essential part that Fourier series play in it. He described how one is led to the concept of the 'reciprocal lattice' and explained, by reference to line gratings, how the theory can be used for the study of crystals deformed in different ways. Finally, he showed how appreciation of the similarity of the diffraction of X-rays and light can help in devising practical methods for crystal analysis. He described an apparatus for observing diffraction at small angles, and showed how it can be used for determining directly the intensities of a zone of reflexions given by the projection of any postulated structure. It can also be used for observing the diffraction pattern given by a single molecule or unit of pattern, and there are thus possibilities of working out structures completely by this means. Great advances may be expected when it becomes possible to work out these methods in greater detail.

After an interval for tea and for the inspection of the exhibition that had been arranged, four short papers on industrial applications were read.

Mr. C. W. Bunn, of Imperial Chemical Industries, Ltd., Northwich, showed some cinematograph films of growing crystals. These provide a great deal of evidence of the manner in which crystals are formed, and Mr. Bunn emphasized that there is still no complete explanation of all the phenomena observed.

Dr. A. H. Jay, of the United Steel Companies, Stocksbridge, described some results he has obtained on the correlation of the crystal structure, hardness and magnetic properties of some iron – chromium – nickel alloys. The face-centred cubic structure changes partly to body-centred cubic when the alloy is drawn into wire, and the changes of structure and hardness can be followed across the section of the wire.

Dr. I. MacArthur described the rotating anode X-ray tube in use at the Textile Physics Laboratory, University of Leeds. This tube differs from others in the smallness of the power it uses; the great efficiency is due to the fineness of its focus. That this is an important factor was shown by slides in the lecture and by prints in the exhibition; for example, there were fibre photographs taken with an exposure of less than a minute that would have taken hours with ordinary apparatus (see NATURE, July 10, p. 38).

Finally, Mr. L. D. Brownlee, of the Metropolitan-Vickers Electrical Company, Ltd., Manchester, described the use he has made of X-rays in the study of sintered carbides used for tool-tips. The subject is peculiarly suited to X-ray examination, and the information that has been obtained about the equilibrium diagrams of the components has proved extremely useful in understanding the nature of the reactions involved in the process of manufacture.

A lively discussion of the various papers followed. The interest shown and the attendance of nearly three hundred people at the meeting augur well for the future of the Group and of X-ray analysis in general. Further particulars about the Group can be obtained from Dr. H. Lipson, Crystallographic Laboratory, Free School Lane, Cambridge.

## THE FREEDOMS OF SCIENCE

AN address on "The Freedoms of Science" was given by Sir Robert Watson-Watt at an open meeting organized by the North-West Area of the Association of Scientific Workers in the Manchester College of Technology on October 18.

Sir Robert said that the demand for more central planning of science comes from people with a passionate sense of social responsibility. This demand has produced fears and fairly widespread opposition, some of which came from distinguished men of science of undoubted sincerity. There is a gap between these points of view, and he believes that it is both narrow and narrowing. The classical definition of science as organized knowledge is confusing, because it suggests a wholly artificial separation between pure science and technology. In Sir Robert's opinion, civilization began in technology, and pure science arose later when technology had made possible the leisure necessary for its pursuit; but to-day the applied scientist uses the same strict criteria of accuracy and logical evaluation as does the pure scientist.

Considering the position in the universities, Sir Robert maintained that pure science is already subject to planning. In addition there is a strong element of industrial planning; industrial undertakings make subventions to university departments. By whatever means a university is financed there is some form of budgetary control, and this control should be planned.

Sir Robert said he had discovered no debate about the need for some measure of planning in the application of science in war-time, but planning in hope for peace is nobler and more productive than planning for war through fear. One of the benefits of technology is to remove drudgery, but unless its application is planned, the result will be unemployment. A large part of scientific effort should be diverted to present needs, but pure science should also receive adequate provision. The facilities which the planners demand for pure science are on a scale which, rather curiously, is vastly greater than the 'freedomists' feel to be necessary. No 'direction' of labour in the scientific world is envisaged. The individual man of science must have the freedom to learn, think, choose, work and speak, but must never claim freedom from self-explanation, external criticism and social responsibility. There is a danger from overplanning, but it is slight. A potential Newton might remain mute and inglorious, submerged in a routine technological process, but that is unlikely to happen.

The kind of planning Sir Robert desired would provide for the free exchange of information. Some very successful planning bodies have been set up during the War, and could be copied in times of peace. The structure should be wholly democratic, and should enable the user to meet the research worker and state his requirements, and the research worker to explain what is and is not practicable. It would be necessary to bring the young bench-worker into the council chamber occasionally for this purpose. The planning of science is obtainable easily, smoothly and productively, and without danger to the freedom of fundamental science.

During the discussion, Prof. M. Polanyi said that, unlike Sir Robert, he believed that pure science should not be confused with technology. The search for organized knowledge, he said, cannot be planned, and it would be disastrous to attempt it. If pure scientists were

diverted from their present work to something else, the work they are doing must suffer. If no such diversion is contemplated, it is unnecessary to raise the question of planning. He realized that such diversion is necessary in time of war or great emergency, but we should never lose sight of the implications of such proposals. One speaker suggested that this difficulty could be overcome by training more scientific men.

## FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

### Saturday, November 6

NUTRITION SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1).—Conference on "Post-War Nutritional Relief".

SOCIETY OF CHEMICAL INDUSTRY (GLASGOW SECTION) (joint meeting with the SCOTTISH GROUP OF THE NUTRITION SOCIETY) (at the Royal Technical College, 204 George Street, Glasgow), at 2.30 p.m.—Discussion on "Diet in relation to Industrial Health".

LONDON SCIENTIFIC FILM SOCIETY (at the Imperial Institute Cinema, Exhibition Road, South Kensington, London, S.W.7), at 5 p.m.—Coal; VIEM; Pavlov Experimental Farm; Neuropsychiatry.

### Monday, November 8

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 8 p.m.—Dr. Douglas Guthrie: "Greece and Aegean Islands" (with Kodachrome Films).

### Tuesday, November 9

SOCIETY OF CHEMICAL INDUSTRY (CHEMICAL ENGINEERING GROUP) (joint meeting with the MANCHESTER SECTION OF THE SOCIETY and the INSTITUTION OF CHEMICAL ENGINEERS) (at the College of Technology, Sackville Street, Manchester 1), at 2.30 p.m.—Major V. F. Ghesq and Mr. R. J. Barritt: "The Manufacture of Sulphuric Acid in Contact Plants".

INSTITUTION OF CIVIL ENGINEERS (RAILWAY ENGINEERING DIVISION) (at Great George Street, Westminster, London, S.W.1), at 5 p.m.—Mr. C. E. Fairburn: "The Electrification of the Wirral Lines of the L.M.S. Railway".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Henry Dale, G.B.E., P.R.S.: "Progress in the Treatment of Infections", 2: "The Beginnings and Growth of Chemotherapy".*

### Wednesday, November 10

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. P. B. Morris: "Education To-day and To-morrow", 1: "English Education As It Is".

SOCIETY OF CHEMICAL INDUSTRY (FOOD GROUP, MICROBIOLOGICAL PANEL) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2 p.m.—Dr. J. Ramsbottom: "Fungi as Food".

PHYSICAL SOCIETY (COLOUR GROUP) (joint meeting with the TECHNICAL SECTION OF THE PAPER MAKERS' ASSOCIATION OF GREAT BRITAIN AND IRELAND) (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 2.30 p.m.—Mr. S. R. H. Edge: "Colour Measurement for Control and Research in Paper Making".

CHEMICAL SOCIETY (joint meeting with the GLASGOW UNIVERSITY ALCHEMISTS CLUB and the ANDERSONIAN CHEMICAL SOCIETY) (in the Chemistry Department, The University, Glasgow), at 3.30 p.m.—Prof. John Read, F.R.S.: "Humour and Humanism in Chemistry".

ROYAL METEOROLOGICAL SOCIETY (at 49 Cromwell Road, South Kensington, London, S.W.7), at 4.30 p.m.—Papers.

### Wednesday, November 10—Thursday, November 11

BRITISH COAL UTILISATION RESEARCH ASSOCIATION (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1).—Conference on "Problems in the Utilisation of Small Coals".*

**Wednesday, November 10**

At 2.30 p.m.—"The Utilisation of Small Coals and Slurries".

**Thursday, November 11**

At 10 a.m.—"The Utilisation of Fuels of High Inert Content".
At 2.30 p.m.—"The Upgrading of Fuels".

### Thursday, November 11

CHADWICK PUBLIC LECTURE (at the Royal Sanitary Institute, 90 Buckingham Palace Road, London, S.W.1), at 2.30 p.m.—Mr. J. H. Forshaw: "Town Planning and Health" (Bosom Gift Lecture).*

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "The Methods of Modern Astronomy", 2: "Photographic Astronomy".*

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 3.15 p.m.—Mr. H. S. Souttar: "Physics and the Surgeon" (Bradshaw Lecture).

SOCIETY OF CHEMICAL INDUSTRY (NEWCASTLE SECTION) (joint meeting with the ROYAL INSTITUTE OF CHEMISTRY, CHEMICAL SOCIETY, and OIL AND COLOUR CHEMISTS ASSOCIATION) (in the Lecture Theatre, King Edward School of Art, King's College, Newcastle-upon-Tyne), at 6 p.m.—Mr. I. W. A. Kirkwood and Dr. P. D. Ritchie: "Plastics".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 7 p.m.—Mr. M. A. H. Tincher: "The Use of Plant Growth Substances".

### Friday, November 12

ROYAL ENTOMOLOGICAL SOCIETY OF LONDON (joint meeting with the BRITISH ECOLOGICAL SOCIETY) (at 41 Queen's Gate, South Kensington, London, S.W.7), at 2.30 p.m.—"The Inter-relations of Plants and Insects—the Place of Both in the Eco-System" (Speakers: Prof. E. J. Salisbury, F.R.S., Dr. E. A. Cockayne, Capt. Cyril Diver and Dr. C. F. C. Beeson).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Dr. C. D. Darlington, F.R.S.: "The Origin of Cultivated Plants".

CHEMICAL SOCIETY (in the Chemistry Lecture Theatre, The University, Sheffield), at 5.30 p.m.—Prof. N. K. Adam, F.R.S.: "Surface Films".

CHEMICAL SOCIETY (joint meeting with the UNIVERSITY COLLEGE OF BANGOR CHEMICAL SOCIETY) (in the Chemistry Lecture Theatre of University College, Bangor), at 5.30 p.m.—Prof. M. Polanyi: "The Strength of Carbon Bonds".

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Mr. W. E. Ballard: "Reclamation of Worn Parts by the Metal Spraying Process"; Mr. W. Andrews: "Building-up and Hard-Surfacing by Welding"; Mr. A. W. Hothersall: "The Repair of Worn or Over-machined Parts by Electro-Deposition".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Dr. T. H. Havelock, F.R.S.: "The Approximate Calculation of Wave Resistance at High Speed"; Dr. J. Lockwood Taylor: "Pressure Distribution on Propellers".

### Saturday, November 13

BIOCHEMICAL SOCIETY (in the Department of Organic Chemistry, Imperial College of Science and Technology, South Kensington, London, S.W.7), at 11 a.m.—Discussion on "The Tetrapyrrolic Pigments".

At 11.15 a.m.—Prof. D. Keilin, F.R.S.: "Properties and Function of Natural Tetrapyrrolic Compounds".

At 12.10 p.m.—Prof. H. Munro Fox, F.R.S.: "Varieties of Hæmoglobin".

At 1.45 p.m.—Mr. R. Hill: "Tetrapyrrolic Compounds in Plants".

At 2.35 p.m.—Dr. E. R. Hartree: "The Constitution of Catalase".

At 3.15 p.m.—Mr. J. R. P. O'Brien: "The Metabolism of Blood Tetrapyrrolic Pigments".

At 4.30 p.m.—Dr. C. Rimington: "The Porphyrinopathies".

## APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEPUTY CITY SURVEYOR AND ENGINEER—The Town Clerk, Town Hall, Manchester 2 (endorsed 'Deputy City Surveyor and Engineer') (November 10).

TWO SCIENCE MASTERS (OR MISTRESSES) to share the teaching of Chemistry and Physics in the Wellingborough Grammar School to Higher School and Scholarship standard—The Secretary for Education, County Education Offices, Northampton (November 11).

TRANSPORT MANAGER AND ENGINEER—The Town Clerk, Town Clerk's Office, Tonbridge Road, Maidstone (November 12).

TEAM LEADER FOR ENTOMOLOGICAL WORK in connexion with scheme of the Ministry of Agriculture for Pest Control—Prof. R. G. White, School of Agriculture, University College of North Wales, Bangor (November 12).

GRADUATE ASSISTANT MASTER with special responsibility for the Technical Department (a Physicist with ability to teach Mathematics is being sought, and preference will be given to candidates with some knowledge of Engineering and/or Industrial Experience)—The Principal, South Dorset Technical College, Newstead Road, Weymouth (November 12).

EDUCATIONAL PSYCHOLOGIST (part-time) to undertake work at the Chislehurst Child Guidance Clinic—The County Medical Officer, County Hall, Maidstone (November 13).

LECTURER IN PHYSICS (graduate with, preferably, high qualifications in Physics, and able to teach classes in Elementary Mathematics)—The Director of Education, The Polytechnic, 309 Regent Street, London, W.1 (November 15).

LECTURER IN MECHANICAL OR PRODUCTION ENGINEERING SUBJECTS up to Higher National Certificate standard in the County Technical College, Wednesbury—The Director (H), County Education Offices, Stafford (November 15).

ASSISTANT (temporary) IN THE DEPARTMENT OF GEOGRAPHY—The Registrar, The University, Leeds 2 (November 15).

LABORATORY TECHNICIAN (must hold Certificate of Institute of Medical Laboratory Technology, or its equivalent, and have considerable experience in Biochemistry)—The Medical Director "R.3", Staines County Hospital, Ashford, Middlesex (November 18).

TECHNICIANS (highly skilled in Bacteriological and Serological Venereal Disease technique) for a Bacteriological Laboratory—The Town Clerk, The Guildhall, Nottingham (November 20).

PROFESSOR OF ENGINEERING—The Registrar, University College, Singleton Park, Swansea (November 20).

ASSISTANT (temporary) to teach Mathematics and other Junior Engineering Subjects—The Principal, County Technical College and School of Art, Newark, Notts. (November 22).

PSYCHOLOGIST (with an Honours Degree in Psychology, experience of testing, remedial teaching, and preferably child guidance work)—The Medical Superintendent, Central Mental Hospital, near Warwick (December 4).

CITY ENGINEER AND SURVEYOR—The Town Clerk, Town Clerk's Office, St. Albans (endorsed 'City Engineer') (December 10).